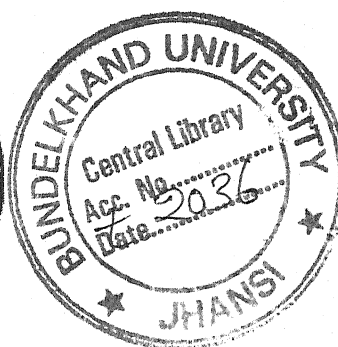


**“PROBLEMS AND PROSPECTS OF MARKETING
OF LPG COMMERCIAL CYLINDER IN INDIA:
A STUDY OF PUBLIC AND PRIVATE SECTOR
DISTRIBUTION AGENCIES”**



**Thesis Submitted for the Award of the Degree
of
Doctor of Philosophy
(FACULTY OF COMMERCE)
To
Bundelkhand University, Jhansi (U.P.)
2006**

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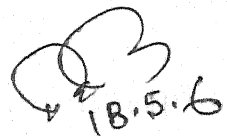
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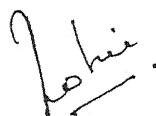
- That the thesis embodies the work of the candidate, Mr. Rohin Vishwanathan, himself.
- That the candidate worked under me for the period required under ordinance.
- That he has put the required attendance in my faculty during that period.


(Dr. D.C. Agarwal)

DECLARATION BY THE CANDIDATE

I Declare that the thesis entitled "Problems and Prospects of Marketing of L P G Commercial Cylinder in India: A Study of Public and Private Sector Distribution Agencies", is my own work conducted under the supervision of Dr. D.C. Agarwal. The results presented in this study have not been submitted, in full or part, in this or any other university for the award of any degree or diploma.

My indebtedness to other work / publications has been duly acknowledged at the relevant places.



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Preface

The LPG industry has expanded rapidly over the past decade and undergone many profound changes. Utilization of LPG as fuel in residential and commercial markets has more than doubled in many developing countries. LPG consumption has expanded at nearly twice the rate of world petrochemical demand, and LPG demand has now surpassed jet fuel consumption on a global basis. Markets for LPG (and other petroleum products) have been opened in many countries, accelerating demand growth rates and creating investment opportunities in all segments of the downstream LPG industry - including terminaling, storage, distribution and marketing.

The prospects for the LPG industry appear promising as we approach the next millennium. Markets for LPG in developing countries should continue to expand as more and more customers are introduced to LPG and infrastructure is added to efficiently distribute and market the product. While LPG consumption has already grown quickly in several emerging markets, per capita LPG consumption in most developing regions remains substantially below consumption patterns in well-established markets such as Japan, North America and Western Europe. Thus, significant growth potential remains in developing countries such as China and India.

The petrochemical industry has experienced a period of sustained strong expansion over the past decade, significantly increasing the need for feedstocks. As a result, the base demand for LPG feedstocks (in plants specifically designed for LPG and/or ethane) has grown rapidly and the ability of flexible petrochemical plants to absorb LPG supplies available for price-sensitive markets has steadily

risen. The petrochemical industry is having a particularly important influence on LPG markets in North America, Western Europe, and the Middle East. The petrochemical feedstock market is expected to remain a strong growth market for LPG (and other feedstocks such as naphtha and ethane) over the medium to long-term as global petrochemical demand growth continues to outpace energy demand growth.

As discussed above, the prospects for continued expansion of the LPG industry into new and traditional markets appear reasonably strong. However, there are several uncertainties that will probably influence the development of the global LPG market as well as regional markets. The Asian financial crisis will undoubtedly result in some economic changes in countries that are directly involved in the crisis, and it may spill over into other Asian economies that are not directly involved in the crisis. This could have a potentially significant impact on LPG demand growth in several countries over the short to medium term and might delay or cause cancellation of regional supply projects.

Asian LPG import requirements have been growing faster than Middle East export availability since the late 1980s. If this trend continues, Asian import requirements could outstrip supplies in the East of Suez region, creating the need for movements from non-traditional sources and putting upward pressure on regional prices. Considerable uncertainty remains about future Middle eastern LPG supplies, particularly from Iran, Iraq, and Saudi Arabia.

The Atlantic Basin region has seen a considerable increase in activity related to LPG supply projects during the 1990s. North Sea LPG supply levels have nearly doubled and additional production gains are anticipated in the future. African supplies are increasing with expansion

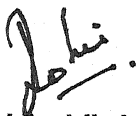
projects in Algeria and the startup of new facilities in Western Africa. North America remains a very large incremental market for LPG, but new projects in Western Canada and the U.S. Gulf of Mexico are increasing LPG supplies in the region. Latin America is expanding LPG production rapidly, and is moving from a net LPG importer to a net exporter. With all of these developments, LPG markets in the Atlantic Basin region are expected to remain dynamic and will probably undergo many important changes in the future.

Thus the need arises to know why in India there are problems in marketing of commercial cylinders by all the companies for this purpose the research has been done.

Present worked **Chapter I** discusses with the Importance of Marketing, Nature of Research, Sources of Data, Design of Sampling, Coverage and Depth of Survey, Period of Study. **Chapter II** discusses with Brief Introduction of the LPG Industry, Profile of BSL, SHV, and S.W.O.T Analysis of these companies. **Chapter III** discusses with Profile of Public sector companies, Their Business Activities, Their Manufactured Products, Their Landmarks, Their Marketing Activities, Their Range of Cylinders, and Their Services provided to the customers, Their Future Plans. **Chapter IV** discusses with the Marketing of commercial cylinder by private and public sector companies with the help of Market Segmentation, Market Positioning, Product, Swot Analysis, Publicity and Advertising, Competition in world market and major competitors, Competitive Strategies, Production planning and control. **Chapter V** does the comparative study Private sector companies and Public sector companies with the reference to Market Share, Pricing, Sales, Quality, Range of Cylinders, Features of cylinders, After Sales Service. **Chapter VI** gives the whole analysis of

the survey data with the help of table's graphs and the interpretations made. **Chapter VII** gives the summary of Broad findings and recommendations of the research.

April 2006
Jhansi


Rohin Vishwanathan

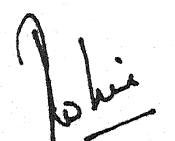
ACKNOWLEDGEMENT

In the preparation of this work I have received guidance, assistance and support from magnitude of people, too numerous to be enumerated here. Much I would have wished thanks to each one of them, regret is only mine not be able to do so on account of limits of spaces for each one to whom I have my admiration.

I wish with heart full gratitude to my supervisor, Dr. D.C.Agarwal, Reader, Faculty of Commerce, Bundelkhand P.G College, Bundelkhand University, Jhansi who has been benevolent enough to help me in the completion of this research work. His Deep Understanding and Penetrating Analysis have contributed much to the correct approach to the subject.

I must also express my gratitude to my father, mother and the whole family for encouraging me throughout the research work. I am also grateful to all those officers of BPCL, HPCL, IOCL, SHELL GAS & SHV who provided their help in giving their guidance, Co-operation and help in collecting the data for my present study.

April 2006
Jhansi


Rohin Vishwanathan

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CHAPTER – 1

INTRODUCTION & RESEARCH DESIGN

1. *Importance of Marketing*
2. *Nature of Research*
3. *Sources of Data*
4. *Design of Sampling*
5. *Coverage and Depth of Survey*
6. *Period of Study*

CHAPTER – I

INTRODUCTION & RESEARCH DESIGN

1. Importance of Marketing

Philip Kotler¹, the acknowledged guru of marketing, defines marketing as: *"a social and managerial process by which individuals and groups obtain what they need and want through creating, offering, and exchanging products of value with others"*.

Others have said that company marketing skills can launch a new era of high economic growth and living standards.

Both ideas are built upon the Marketing Concept that was introduced in the mid-1950s, which states: *"The marketing concept holds that key to achieving organizational goals consists in determining the needs and wants of target markets and delivering the desired satisfaction more effectively and efficiently than competitors"*².

Again quoting Kotler, *"Marketing management is accomplished by carrying out marketing research, planning, Implementation, and control"*. Meaningful marketing and strategic planning relies on management's ability to develop and maintain a marketing information system and have the skills to carry out sound marketing research.

¹ Marketing Management By Philip Kotler

² Marketing Management By Philip Kotler

1. If marketing is the engine that drives the economy, then marketing research is the process that keeps the engine tuned.
2. Classical marketing research is gathering data about goods and services
 - The emphasis on marketing is on the identification and satisfaction of customer needs.
 - In order to determine customer needs and for implementing marketing strategies and programs aimed at satisfying those needs, marketing managers need information. They need data about customers, competitors, and other forces in the marketplace.
 - The task of marketing research is to assess the data needs and to provide management with relevant, accurate, reliable, valid, and current data.
 - Recently research firms have been requested to analyze the data and provide marketing intelligence and information.
 - Importance of research can be gauged by the wide range of organizations that use marketing research:
 - ◆ Small businesses
 - ◆ Large businesses
 - ◆ Manufacturing companies
 - ◆ Technology companies
 - ◆ On-line marketers
 - ◆ Policy makers
 - ◆ Professional services
 - ◆ Non profit organizations
 - ◆ Government Organizations

Marketing research, as a profession, has made many important contributions to the marketing process. Marketing research has been used to hasten the introduction of successful new products and services to the market place.

New ideas and concepts have been screened before businesses make huge investments in plant and material on products which consumers would not support. Product formulations have been improved by means of consumer input through various research techniques. In fact, the industry has played a major role in managing every aspect of the marketing mix, from pricing to promotion for the world's leading manufacturers and service organizations.

Marketing is a comprehensive term and it includes all resources and a set of activities necessary to direct and facilitate the flow of goods and services from producer to consumer in the process of distribution. Businessmen regard marketing as a management function to plan, promote and deliver products to the clients and customers.

The American marketing Association defines marketing as a process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives.

Paul Mazur defined marketing as the creation and delivery of a standard of living to the society. This definition catches the real spirit of the marketing process. It has consumer orientation and duly honors the marketing concept, which indicates a shift from product to customer orientation, i.e. fulfillment of customer's needs and desires.

Marketers all over the world are witnessing an unlimited potential for global business and marketing development. The present marketing environment is so turbulent and dynamic that it requires a correct pool of marketing mix. The marketing universe has undergone tremendous changes in the economic, technological, social and political spheres. In a fast changing environment, marketing management has to meet the challenge of managing the change, achieve progress and prosperity through marketing innovations.

Hence, integrated marketing planning and strategies will be the key to the survival of free enterprise system. The managerial marketing buyers of any organization today stresses the reality of new marketing era, which is synthesis of customer needs, business and social interests.

FUTURE SUCCESS FOR THE ORGANIZATIONS

As already depicted that marketing managers are bound to be more customer oriented. Profits rather than sales volume will be given top consideration. But profits will be earned, as a reward for serving the customer wants. Above all, marketing managers have to work together more with the managers of other functional departments in order to realize total corporate objectives as depicted in the company master plan and strategy.

Future success hence will be assured only by having the right product lined with the right promotion at the right price and in the right place. What is right is to be decided by the customer.

MARKETING PROCESS

Marketing has been viewed as an ongoing or dynamic process involving a set of interacting activities dealing with a market offering by producers to consumers on the basis of reliable marketing anticipation. Marketing is a matching process by which a producer provides a ***marketing mix***. (Product, price, promotion and physical distribution) that meets consumer demand of a target market within the limits of a society. Each producer or seller has certain goals and capabilities in making and marketing his products. He uses marketing research as a tool to anticipate market demand. Then he provides a marketing mix in order to capitalize marketing opportunity.

Hence the next concept to discuss is *marketing mix*, **which** is a linking pin between the producers and the ultimate customers.

MARKETING MIX

Marketing mix is the set of marketing tools that the firm uses to pursue its marketing objectives in the target market.

McCarthy classified these tools into four broad groups that he called the four Ps of marketing: product, price, and promotion. Marketing-mix decisions must be made for influencing the trade channels as well as the final consumers. Below figure shows the company preparing an offering mix of products, services, and prices and utilizing mail, telemarketing and internet to reach the trade channels and the target customers.

Typically, the firm can change its price, sales force size, and advertising expenditure in the short run .It can develop new products and modify its distribution channel only in long run. Thus the firm typically makes fewer period-to-period marketing mix changes in the short run than the number of marketing-mix decision variables might suggest.

Note that the four Ps represent the sellers' view of the marketing tools available for influencing buyers. From a buyers point of view, each marketing tool is designed to deliver a customer benefit .Robert Lauterborn suggested that the sellers four Ps correspond to the customers four Cs.

Four Ps

Product

Price

Four Cs

Customer Solution

Customer Cost

Place

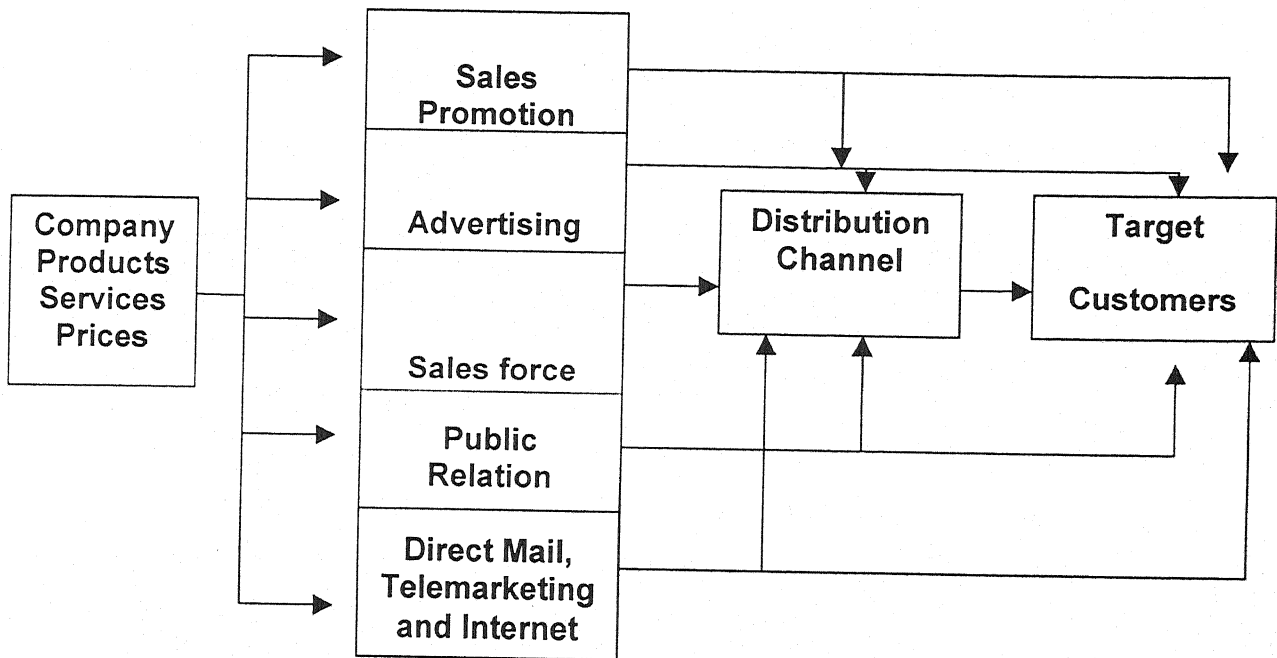
Promotion

Convenience

Communication

Winning companies will be those who can meet customer needs economically and conveniently and with effective communication

Promotion Mix³



³ Made through Study

WHAT IS A MARKET?

A market can be discussed based on the following concepts: -

Place Concept A market may be considered as a convenient meeting place where buyers and sellers gather together for exchange of goods.

Area Concept According to this concept the meeting place is not necessary. It is a matter of convenience only.

Demand Concept Which states that today a market is equated with total demand which means a group of people having unmet wants, purchasing power and the will to spend their income to fulfill these wants.

Under keen competition, a marketer wants to create or capture and retain the market (Customer demand through an appropriate marketing mix offered to a target market)

After getting a brief view of what market is, let us proceed towards the understanding of the word *marketing*.

MARKET SHARE

Company sales do not reveal how well the company is performing relative to competitors. For this purpose, management needs to track its market share.

Market share can be measured in three ways :

➤ **Overall market share**

It is the companies sales expressed as a percentage of total market sales

➤ **Served Market Share**

Served market share is its sales expressed as a percentage of the total sales to its served market .Its served market is all the buyers who are able and willing to buy the product. Served market share is always larger than overall market share .A Company could capture 100 percent of its served market yet have a relatively small share in the total market.

➤ **Relative market share**

It can be expressed as a market share in relation to its largest competitor .A relatively market share over 100 percent indicates a market leader. A relative market share of exactly 100 percent meets that the company is tied for the lead .A rise in relative market share means a company in gaining on its leader competitor.

MARKET POTENTIAL

The market forecast shows expected market demand, not he maximum market demand .For the latter, we have to visualize the level of the market demand resulting from a "very high" level of the industry marketing expenditure, where further increase in marketing efforts would have little effect in stimulating further demand.

Market potential is the limit approached by market demand as industry marketing expenditure approach infinity for a given marketing environment.

The phrase "for a given market "is crucial. Consider the market potential for LPG in a period of recession versus a period of prosperity. Market analyst distinguishes between the position of the market demand function and movement along it. Companies cannot do anything about the position of the market demand function, which is determined by the marketing environment.

WHY TO MEASURE MARKET POTENTIAL

The average business loses in the market share of the company each year often without knowing

- What are the reasons for the decrease in the market share of the company
- Why the market potential is decreasing
- At what position market reached break even point

NEED FOR THE MARKET POTENTIAL

The market potential determine that how much the company can excel itself in the LPG world with respect to its competitors in the market .it is very important in case of market potential to know the following:

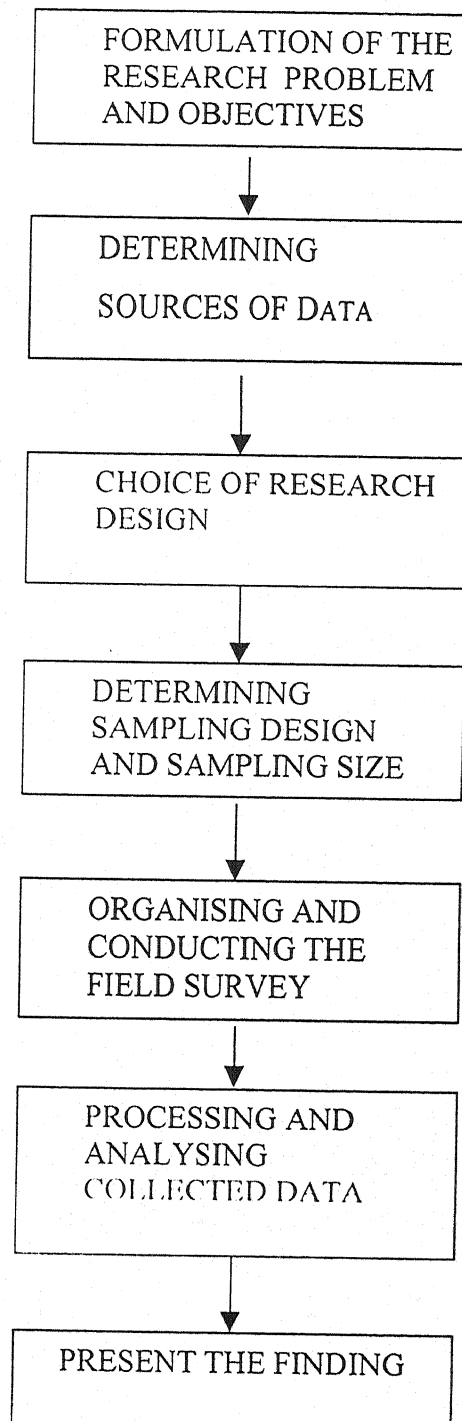
- To know what are the reasons for the decreases in the market share of the company to the previous year
- To know the market potential of the companies with respect to its position
- To know more and more ways company can utilize their efforts to raise potential of the company

TOTAL MARKET POTENTIAL

Total market potential is the maximum amount of sales that might be available to all the firms in an -industry during a given period under a given level of industry marketing efforts and given environmental conditions .A common way to estimate total market potential is as follows: Estimate the potential number of the buyers times the average quantity purchase by the buyer times purchase.

2. Nature of Research

Research Process⁴



⁴ Research Methodology C.R Kothari

Research Problem and Objective

A complete problem definition and objective consist of the following:

Unit of Analysis:

In my study the consumer of "Commercial Gas Cylinder" is unit of analysis.

Characteristics of Interest:

In my study characteristics of Interest is "Marketing Problems and comparative study of public and private sector distribution agencies in the distribution of commercial gas cylinder"

Research Design

Type of Research:

I would be using Analytical and Descriptive type of research. It is one which includes surveys and fact-finding enquiries of different kinds. The major purpose of such research is description of the affairs, as it exists at present.

3. SOURCES OF DATA

For my research data will be procured from both primary sources and secondary sources.

Primary Data:

I would collect primary data through Questionnaire

Secondary Data:

Books, Newspapers , magazine and web sites journals and manuals will be constituted as the secondary source.

Research Approach:

In my research both approaches will be used i.e. *Quantitative* and *Qualitative*.

Research Instrument

Questionnaire

Types of Questionnaire

In my Survey the Questionnaires will be structured-direct questionnaires.

Type of Questions

I used dichotomous and Multiple-choice Questions in Questionnaire.

4. DESIGN OF SAMPLING

Sample Plan

A sample is a definite plan for obtaining a sample from a given population. it refers to the technique or a procedure the researcher would adopt in selecting items for the sample. It includes the following.

Sampling Unit

In my research the sampling unit would be Commercial gas cylinder customers.

5. COVERAGE AND DEPTH SURVEY

Sample Size

Maharastra :

1. Pune : 10 Questionnaire surveys of the distribution agencies of each company.
2. Mumbai : 10 Questionnaire surveys of the distribution agencies of each company.
3. Nasik : 10 Questionnaire surveys of the distribution agencies of each company.
4. Nagpur : 10 Questionnaire surveys of the distribution agencies of each company.

Total 200 Questionnaires.

The Sampling Procedure followed would be Random Probability Sampling.

6. PERIOD OF STUDY

I have been researching on this Topic from 1.04.04 till Date

CHAPTER - II

PROFILE OF PRIVATE SECTOR COMPANIES

1. *Brief Introduction of the Industry*
2. *Profile of BSL, SHV*
3. *S.W.O.T Analysis of these companies*

CHAPTER – II

PROFILE OF PRIVATE SECTOR COMPANIES

1.Introduction of the Industry

The international LPG industry has expanded rapidly over the past decade and undergone many profound changes. Utilization of LPG as fuel in residential and commercial markets has more than doubled in many developing countries. LPG consumption has expanded at nearly twice the rate of world petrochemical demand, and LPG demand has now surpassed jet fuel consumption on a global basis. Markets for LPG (and other petroleum products) have been opened in many countries, accelerating demand growth rates and creating investment opportunities in all segments of the downstream LPG industry-including terminaling, storage, distribution and marketing.

The prospects for the international LPG industry appear promising as we approach the next millennium. Markets for LPG in developing countries should continue to expand as more and more customers are introduced to LPG and infrastructure is added to efficiently distribute and market the product. While LPG consumption has already grown quickly in several emerging markets, per capita LPG consumption in most developing regions remains substantially below consumption patterns in well-established markets such as Japan, North America and Western Europe. Thus, significant growth potential remains in developing countries such as China and India.

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need for feedstocks. As a result, the base demand for LPG feedstocks (in plants specifically designed for LPG and/or ethane) has grown rapidly and the ability of flexible petrochemical plants to absorb LPG supplies available for price-sensitive markets has steadily risen. The petrochemical industry is having a particularly important influence on LPG markets in North America, Western Europe, and the Middle East. The petrochemical feedstock market is expected to remain a strong growth market for LPG (and other feedstocks such as naphtha and ethane) over the medium to long-term as global petrochemical demand growth continues to outpace energy demand growth.

As discussed above, the prospects for continued expansion of the LPG industry into new and traditional markets appear reasonably strong. However, there are several uncertainties that will probably influence the development of the global LPG market as well as regional markets. The Asian financial crisis will undoubtedly result in some economic changes in countries that are directly involved in the crisis, and it may spill over into other Asian economies that are not directly involved in the crisis. This could have a potentially significant impact on LPG demand growth in several countries over the short to medium term and might delay or cause cancellation of regional supply projects.

Petroleum products play a vital role in every industry. Barring LPG with nearly 85% domestic consumption, all other products used across industries.

In country with 1000mn population the LPG customer is about 40mn. This is a market, which is expected to register a CAGR of 12% for next five years (2006).

The present players in LPG market are HPCL, BPCL, SHV, SHELL GAS, and RELIANCE.

LPG predominantly consists of saturated hydrocarbons –propane and butane.

Liquefied petroleum gas (LPG) is an efficient and clean medium of energy. Apart from its use as cooking fuel world over, the product has several application such as running automobiles, operating consumer durables like washing machines, room heaters, air conditioners etc.

In India LPG was primarily used as a cooking fuel in urban and semi – urban areas. Ironically, in a country with a population of 1000mn this efficient cooking medium has reached only 28mn household (as per 1991 census) then LPG connections should reach at least 54mn household, which translates into additional 5.2mtpa(millions ton per annum) of LPG consumption. Further, if 20% of rural population start consuming LPG, it would work to another 20mn households, which means an additional requirement of 4.18mtpa of LPG .As per the industry sources back of the envelope calculations suggest that if 40mn households in India own color television (CTV) then the LPG connection should easily double, yet LPG penetration is skewed towards certain areas – couple of reasons for the same:-

- Government encouraged maximum production of middle distillates i.e. HSD High Speed Diesel) and SKO (Superior Kerosene Oil) therefore, LPG production on an average was about 3-4% of the crude processed.

- Infrastructure bottlenecks-Limited investment were directed towards developing storage and bottling facilities. PSU's(Public Sector Undertakings)had the practice of Rationing LPG connections for semi –urban areas, talukas and other smaller districts due to lack of sufficient storage facilities, refilling problem etc.
- Subsidizing policy discouraged private investments.

TABLE 2.1 : Private Import Terminals in India¹

NO	COMPANY	PLACE	COMPONENT
1	SHV	Vizag	(LPG Mix)
2	HALPG	Mumbai	(LPG Mix)
3	SPIC-CALTEX	Tuticorin	(LPG Mix)
4	IPCL	Mumbai	(Propane)
5	Reliance	Okha	(not in use)
6	Shri Shakti	Kakinada	(LPG Mix)
7	Bharat Shell	Pipavav	(LPG Mix)
8	GCTPCL	Dahej	(LPG Mix)
9	CM Power	Paradeep	(not in use)
10	SHV	Porbunder	(LPG Mix)
11	ELF	Mangalore	(LPG Mix)
12	Aegis Chemical	Mumbai	(LPG Mix)
13	Eastern India Petro	Vizag	(LPG Mix)

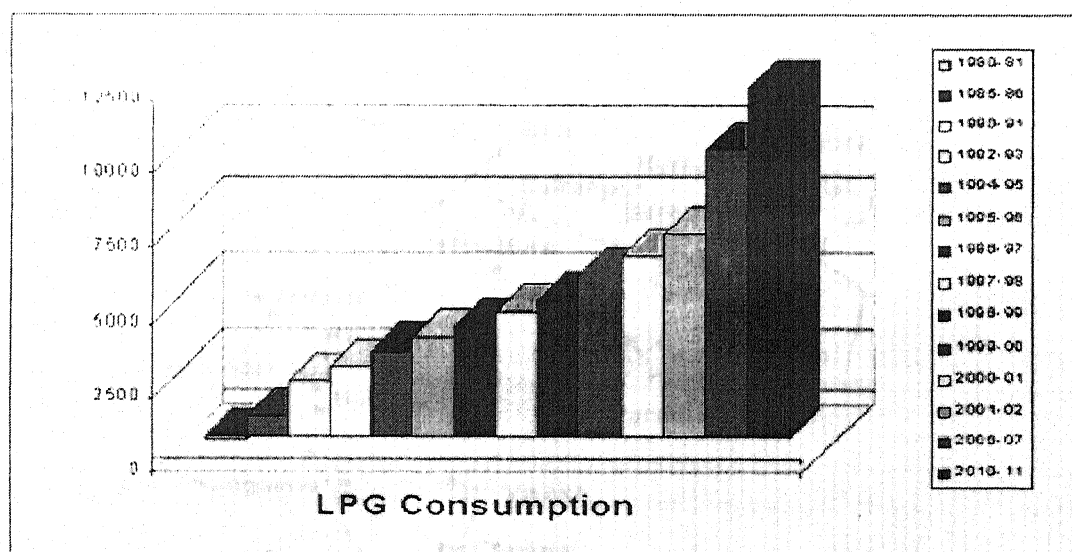
¹ www.Indiainfoline.com

TABLE 2.2 : PSU'S IMPORT TERMINAL²

No	Company	Place
1	IOC	Kandala
2	HPCL	Manglore
3	HPCL	Vizag
4	BPCL	Mumbai
5	BPCL/Finolex	Ratanagiri

GRAPH 2.1³

LPG consumption year wise (In Metric Tons):



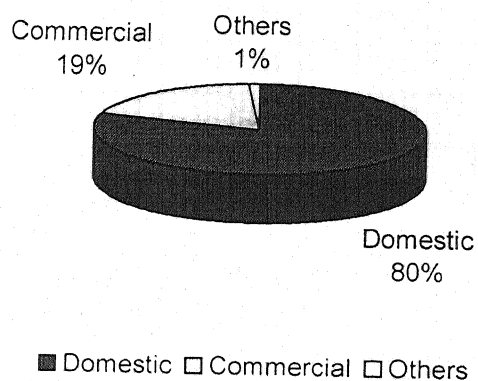
² www.indilpg.com

³ 28th June 2004 India Today

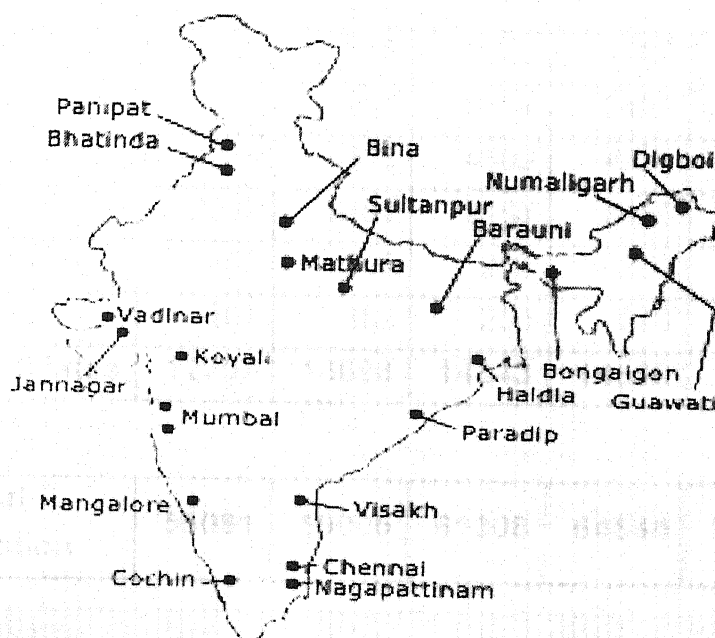
GRAPH 2.2⁴

LPG Consumption by sectors

CONSUMPTION PATTERN



GRAPH 2.3⁵ REFINERIES AND MAJOR PIPELINES IN INDIA



⁴ 31st July 2004 Business World

⁵ www.Indiainfoline.com

TABLE 2.3⁶ Throughput ('000mt)

Year to 31 March	1996	1997	1998	1999	2000	CAGR (%)
LPG	1539	1598	1666	1724	2487	12.7%
MS	4462	4704	4849	5573	6232	8.7%
Naphtha	5975	6123	6103	6081	8170	8.1%
Others	457	458	414	398	1425	32.9%
Light Distillates	12433	12883	13032	13776	18314	10.2%
ATF	2127	2119	2147	2289	2292	1.9%
SKO	5267	6236	6701	5341	5735	2.2%
HSD	20661	22202	23354	26716	34793	13.9%
LDO	1351	1286	1246	1336	1624	4.7%
Others	535	580	485	486	551	0.7%
Middle distillates	29941	32423	33933	36168	44995	10.7%
Lubes	633	619	593	586	728	3.6%
FO	5351	5980	6771	6407	6559	5.2%
LSHS	4228	4318	4309	4623	4793	3.2%
Bitumen	2032	2283	2158	2419	2485	5.2%
Petroleum Coke	256	246	282	286	465	16.1%
Others	207	252	230	279	1072	50.9%
Heavy distillates	12707	13698	14343	14600	15225	4.6%
Total production	55081	59005	61308	64544	79411	9.6%

Source: ministry of petroleum & natural gas

⁶ Ministry of Petroleum

TABLE 2.4⁷ Consumption ('000mt)

Year to 31 March	1996	1997	1998	1999	2000*	CAGR (%)
LPG	3849	4184	4581	5041	6029	11.9
MS	4679	4955	5182	5507	5909	6.0
Naphtha	3669	4015	4716	6652	7970	21.4
NGL	475	682	768	330	91	-33.8
Others	472	548	495	428	474	0.1
Light distillates	13144	14384	15742	17958	20473	11.7
ATF	2082	2158	2108	2112	2197	1.4
SKO	9317	9646	9878	10599	10731	3.6
HSD	32254	35019	36071	37217	39287	5.1
LDO	1311	1223	1235	1278	1512	3.6
Others	495	498	424	480	532	1.8
Middle distillates	45459	48544	49716	51686	54259	4.5
Lubes	711	705	835	885	915	6.5
FO	6496	6534	6651	6767	6816	1.2
LSHS	4189	4313	4323	4537	4763	3.3
Bitumen	2005	2273	2178	2412	2879	9.5
Petroleum coke	319	276	227	315	328	0.7
Others	195	195	166	206	218	2.8
Heavy distillates	13915	14296	14380	15122	15919	3.4
Imports by Pvt. Par.	0	1944	4452	5796	5639	30.5
Total demand	72540	79168	84290	90562	96290	5.0

⁷ Ministry of Petroleum Website :

**TABLE 2.5⁸ Imports of Crude Oil and Petroleum Products
('000 Tonnes)**

Item ('000 tonnes)	1995-96	1996-97	1997-98	1998-99	1999-00
Crude Oil	27342	33906	34494	39808	44989
Pol Products					
1. LPG	678	1035	1087	1525	1377
2. Others	439	455	335	422	241
Light. Distillates	1117	1490	1422	1947	1618
1. ATF	97	150	55	0	1
2. SKO	5001	4279	3812	5823	5491
3. HSD	12852	13608	14075	10485	5408
Middle. Distillates	17950	18037	17942	16308	10900
1. Furnace Oil	1209	694	141	514	483
2. Lubes	58	44	25	11	66
Heavy. Distillates	1267	738	166	525	549
Total Pol Products	20334	20265	19530	18780	13067
Total (A+B)	47676	54171	54024	58588	58056

⁸ Ministry of Petroleum & Natural gas

TABLE 2.6⁹ Exports of Crude Oil and Petroleum Products
('000 Tonnes)

Item ('000 tonnes)	1995-96	1996-97	1997-98	1998-99	1999-00
Crude Oil	0	0	0	0	0
Pol Products					
1. Naphtha	2461	2184	1407	643	214
2. LPG	17	22	21	23	31
3. Others	539	437	670	113	39
Light. Distillates	3017	2643	2098	779	284
1. HSD/LDO	209	216	237	260	278
2. Others	187	221	254	271	308
Middle. Distillates	396	437	491	531	586
1. Furnace Oil / LSHS	22	82	360	91	29
2. Others	0	0	1	0	0
Heavy. Distillates	22	82	361	91	29
Total Pol Products	3435	3162	2950	1401	899
Total (A+B)	3435	3162	2950	1401	899

⁹ Ministry of Petroleum & Natural Gas

**TABLE 2.7¹⁰ SELLING PRICES OF PETROLEUM
& PETRO-CHEMICAL PRODUCTS AS ON 19-6-2001**

PRODUCT	UNIT	MUMBAI	DELHI	CHENNAI	CALCUTTA
MS 87 ON	LITRE	31.27	28.44	30.38	28.92
MS UNLEADED/MS (0.05% SULPHUR)	LITRE	31.73	28.75	30.38	28.92
MS 93 ON	LITRE	35.56	32.28	34.46	32.87
DIESEL	LITRE	20.07	16.55	18.01	16.92
HSD (0.05% SULPHUR)	LITRE	20.67	17.06	N.A.	N.A.
LSHF-HSD	KL	19949.42	16279.01	N.A.	14170.96
LIGHT DIESEL OIL	KL	16466.09	15994.81	14338.85	13998.65
SUPERIOR KEROSENE OIL	LITRE	7.52	7.35	7.50	7.76
SUPERIOR KEROSENE OIL (IND)	KL	16157.72	15301.70	13111.11	16157.72
AVIATION TURBINE FUEL (DOM)	KL	22003.40	20775.46	21827.37	22003.40
NAPHTHA -					
- For Fertiliser Purpose	MT	14993.36	16164.00	15143.80	13806.72
- For General Purpose	MT	19492.14	20935.68	19679.40	17941.71
FURNACE OIL					
- For Fertiliser Feedstock purpose	KL	10252.01	10470.00	10407.52	10758.00
- For Fertiliser Non Feedstock purpose	KL	11892.34	12145.20	12072.72	12479.28
- For General Purpose	KL	11892.34	12145.20	12072.72	12479.28
LSHS					
- For Fertiliser Feedstock purpose	MT	10976.49	11772.00	11142.96	10051.84
- For Fertiliser Non Feedstock purpose	MT	12732.73	13655.52	12925.83	12848.21
- For Power Generating Plants	MT	10976.49	11772.00	11142.96	11076.05
- For General Purpose	MT	12732.73	13655.52	12925.83	12848.21
LPG PACKED - COMMERCIAL(19kg)	CYLIN DER	519.17	487.34	486.73	545.94
LPG PACKED - DOMESTIC (14.2 KG)	CYLIN DER	225.25	222.25	228.65	245.65

¹⁰ Ministry of Petroleum & Natural Gas

REFINERIES OF COMPANIES LOCATED IN INDIA

1. Bharat Petroleum Corporation Ltd (BPCL)

BPCL is a single location refinery with a market share of 21%. The company has about 4407 retail outlets of which 58% is owned by the company. Besides the company has 928 kerosene dealers, 1179 LPG distributors and 124 depots. The company has an installed capacity of 6mtpa, however the company refined over 8.9mtpa of crude oil in 1999. BPCL plans to set up a 6mtpa refinery at Madhya Pradesh. The estimated cost of this refinery is about Rs80bn and is expected to commence operations by FY03.

REFINERIES	METRIC TONS PER YEAR		BB PER DAY	
	1999	2000	1999	2000
MUMBAI	6.9	6.9	139000	139000

2. Hindustan Petroleum Corporation Ltd (HPCL)

The company has two refineries with a total capacity of 13mtpa with a market share of 20%. HPCL has a retail network of 4400 stations of which the company owns about 46%. Besides the company has 1625 kerosene and diesel oil dealers and over 1450 LPG distributors. HPCL plans to set up a 9mtpa refinery at Bhatinda-Punjab, the estimated cost of which is about Rs90bn.

REFINERIES	METRIC TONS PER YEAR		BB PER DAY	
	1999	2000	1999	2000
VIZAG	4.46	7.46	90000	150282
MUMBAI	5.46	5.46	110000	110000

2.1 PROFILE OF BHARAT SHELL LTD

Shell Gas in India is marketed by Bharat Shell Ltd (BSL), a joint venture between Shell Overseas B.V. and Bharat Petroleum Corporation (BPCL). In fact, the use of LPG in India was pioneered by Burmah Shell (a Shell company) under the brand name – Burshane. Consequent to nationalization, its network transferred to government owned oil companies.

In 1993, the Indian government permitted private companies to market LPG and BSL was one of the first companies to enter this sector under the brand name Shell Gas.

Today, Bharat Shell's marketing activities are supported by a supply base, investment in imports and storage facilities and systems to facilitate high standards of customer service.

Shell gas, with a turnover of about Rs 400,000 crore is the world's leading marketer of LPG operating in over 65 countries, serving more than 5crores customers. It is a part of the Royal Dutch shell group of companies, one of the world's leading petroleum companies.

Shell Gas from 1st August 2002 is becoming a new company with the name SHELL GAS (LPG) INDIA PVT LTD with 100% equity of Shell Overseas Investments B.V. It will be a sister concern of Bharat Shell Ltd.

Shell gas in India is driven by **Quality, Dependability, Customer service and Safety**, which ensure satisfied consumers at every stage of the business-from channel members to end customers.

Quality

Shell gas is the straight run gas with pure mixture of propane and butane. It has a calorific value as high as 11800 Kcal/kg. It has a vapour pressure of 3.5- 4.5 kg/cm². The flow rate is 650 gms/kg. This quality helps you in reducing wastage and save more.

Shell internationally has one of the most stringent quality standards. Shell gas strictly adheres to those quality norms and is thus able to offer its customers high quality LPG, which provides clean burning, no soot deposits and an evenly optimum pressure suited for industrial / commercial usage.

Dependability

Shell is one of the largest producer and traders of LPG. It operates LPG ships required for the movement of LPG from production sources to storage terminal. Shell gas's marketing activities in India are supported by this strong supply base, Investments in an import and storage terminal in Pipavav Gujarat and bottling plants in (state where customer is located) and five other states. All this ensures uninterrupted supply of Shell gas to our valued customers. Shell gas has been consistently awarded the **Highest Crisil rating of grade 1**.

Customer service

Shell gas's strong infrastructure and systems, supported by a professional distributors network, ensure the highest standards of customer service. It is further more backed by shell's international expertise, Which enables it to provide support in various aspects of the business.

The family of satisfied Shell gas customers in India is more than 1,30,000 today and growing across the state of Maharashtra, Gujarat, Madhya Pradesh, Rajasthan, Punjab and Haryana.

Safety: For the safety of customers we offer the following:

Safety Training: We would also impart the safety training to your workers

on your request which would help them to handle the LPG properly and in the safe manner as to avoid accidents and reduce wastage, which would lead to more savings.

Safety Audits: We would also do a safety audit of your plant on your request, which help you and your people work in a much safer environment. This can help you in avoiding any major or minor accidents

Shell Gas (LPG) India Private Limited.

415-416, Shri Nand Dham,

Plot 59, Sector 11, CBD Belapur,

Navi Mumbai - 400614

Maharashtra, India

Phone no: +91 22 27566640 / 39595909

Fax no: +91 22 27566659

2.2 PROFILE OF SUPER GAS LTD (SHV)

SHV Holding's group, established a 100 years ago, is a family owned Dutch business, with a group turnover of USD 11 billion and about 30,000 employees, operating in 26 countries worldwide.

SHV Gas, has considerable LPG experience, achieving sales of over 6 million tonnes of LPG in year 2002. Indeed our affiliates, Calor Group Plc. In U.K. and Primagaz in Europe, with over six decades of LPG experience, are considered the world leaders and pioneers throughout the LPG industry. Over the years, SHV Gas, the flagship company of the group has become a world leader in distributing LPG / Propane and its related applications and has been instrumental in powering many industries and homes.

SHV have been setting the industry standards, helping to formulate legislations, developing new products and new uses for LPG and promoting training, especially in safety, for the past 65 years. The high standards of service that our customers receive are due to the 60 years of experience we carry in all aspects of gas installation and delivery.

SHV's success is based on our "people" - our partners, our employees and our customers. Our employees are there to serve you, our customer with the integrity and purposeful commitment to provide you with the highest level of service possible. We are known throughout the world for our professionalism, business ethics, strong values and commitment to customer service.

The ability to operate within a global context, either to serve increasingly sophisticated markets or potentially promising and

demanding ones (like the Indian market for LPG) is a task that is fundamentally tied up with one key decision.

This is more so, when it comes to developing countries like India, where it actually becomes a strategic imperative for long term growth and success. This is the context in which SHV Energy India Pvt. Ltd. drew its Rs. 1,800 Crores blueprint for investments in India.

The LPG position in India in 2003 is:

- Current supply of LPG is only 7.5 million tonnes
- Current demand of LPG is 9.2 million tonnes
- The domestic penetration of LPG is about 31%
- Per capita consumption of LPG in India is less than 8KG p.a.

In this scenario, SHV foresees its mission as a long-term commitment to the LPG market, investing in India to establish LPG infrastructure.

The blueprint is as follows:

- Rs.500 crore has already been invested
- 2 terminals commissioned
- 9 filling plants are already set up in strategic locations close to the customer.

With its well known global expertise in integrated LPG businesses from constructing and operating terminals, to the time the LPG reaches the final consumers in the domestic, commercial or industrial sectors, SHV is confident of ensuring a national LPG brand in the coming years. SHV's growth plans also encompass benefits for the Indian economy and the environment:

- Reducing the country's dependence on fossil fuels and overcoming the current LPG shortage
- Greater availability of LPG in rural areas will reduce deforestation and also help reduce pollution in the environment
- Considerable direct and indirect employment opportunities

SHV firmly believes in fulfilling its social obligations as a company that truly cares for its people, building strong relationships with its customers.

SHV Energy Pvt. Ltd. has set up 2 terminals at Visakhapatnam and Porbandar and 9 filling plants spread across the country to carry out the filling and the supply of gas. This extensive infrastructure is backed by a strong distribution network and a very efficient transportation system to ensure that the customers get their gas on time every time. Being self-sufficient is the company's first step towards having delighted customers.

The Mark Of Excellence : The coveted CRISIL No.1 rating awarded to us by a leading Government approved agency is a crowning testimony of our commitment to our customers, distributors and suppliers, particularly as the rating was awarded to us only after CRISIL had set the toughest parameters testing the overall soundness and strength of our investments and operations.

SUPER Gas is a part of the largest independent distributor of LPG Propane in the world which has been serving the needs of over 30 million customers across 35 countries. At SUPER Gas, we believe that we owe our success to people rather than to our products, winning

their trust and motivating them to excel in the challenges of the industry.

This philosophy extends not just to our employees but also to every one of our business associates, partners, shareholders, distributors and above all to our customers. Together, we strive to build a better world through care, concern and commitment.

3. S.W.O.T Analysis of the Companies

3.1 S.W.O.T Analysis of the Shell Gas

STRENGTHS

- Large international company
- Access to tech know how
- Aggressive Marketing support
- Strong infrastructure

WEAKNESS

- No subsidy from government

OPPORTUNITIES

- Use of our past in India
- Use of joint venture – stability
- Develop planned dense rural market
- Provide care for customer - attitude and interactions
- Assure availability
- High quality LPG
- Speedy decisions to ensure edge
- Focused SPA
- Local quick decision
- Third party filling
- Private marketer consumers

THREATS

- Domestic cylinder supply in commercial outlet

3.2 S.W.O.T Analysis of SHV (SUPER GAS)

STRENGTHS

- Large international company
- Access to tech know how
- Marketing support
- Infrastructure

WEAKNESS

- Organizational study
- Seen as private marketer
- Distribution network not dense
- Assured availability
- Bulk supply source

OPPORTUNITIES

- Use of our past in India
- Use of JV partner – stability
- Develop planned dense rural network
- Assurance of supply

THREATS

- Renewed focus expansion
- Use of additional capital

CHAPTER - III

PROFILE OF PUBLIC SECTOR COMPANIES

1. *Introduction*
2. *Profile of Companies*
3. *Business Activities*
4. *Manufactured Products*
5. *Landmarks*
6. *Marketing Activities*
7. *Range of Cylinders*
8. *Services*
9. *Future*

CHAPTER – III

PROFILE OF PUBLIC SECTOR COMPANIES

1. INTRODUCTION

Four Public Sector Oil Marketing Companies (OMCs) viz., Indian Oil Corporation Limited, Bharat Petroleum Corporation Limited, Hindustan Petroleum Corporation Limited and IBP Co. Limited are engaged in marketing of LPG in the country. With increased availability of LPG, the number of LPG customers enrolled by them has also been increasing. The number of LPG customers served by them, as on 1.4.2005, was about 845 lakh through their network of 9,001 LPG distributors.

Consequent upon liquidation of LPG waiting list in urban areas and availability of new LPG connections across the counter, in existing markets throughout the country, OMCs had set the target for release of about 63 lakh new LPG connections during financial year 2004-05 with a thrust on smaller towns/rural areas which were hitherto virgin markets. OMCs have already commissioned 535 distributorships. During the year 2004-05, OMCs had released about 73 lakh new LPG connections and commissioned 675 LPG distributorships.

MARKETING OF 5 KG LPG CYLINDERS BY OMCs.

PSU Oil Companies had launched 5 Kg cylinders on 16th August 2002 at Shimla, Himachal Pradesh. Since then, scheme has been expanded to all other States as per demand of product.

Basic purpose for launching 5 Kg cylinder was that the small size LPG cylinder in the domestic sector will help in fulfilling the demand of low income groups in urban, semi-urban and rural pockets and also extend

reach to hilly terrain and interior areas on account of convenience in transportation. The LPG connection with 5 Kg domestic cylinder in terms of deposit of Rs. 350/- per cylinder and low cost of refills costing approximately Rs. 110/- is affordable for the low income groups. This will also help in meeting the requirement of economically weaker sections of the society for LPG refills and help in restricting deforestation, ensuring a pollution free, happy and healthy environment. During the year 2004-05, OMCs had released about 1 lakh number of 5 Kg connections in 27 States and 2 UTs. Total customers of 5 kg cylinders are about 2.42 lakh with OMCs as on 1.4.2005.

LPG AS AUTO FUEL

Government has permitted use of LPG, being a clean and environmentally friendly fuel, as an auto fuel. For this purpose, MOP&NG along with other concerned Ministries/departments has formulated necessary Legislative and Regulatory framework for safe usage of LPG as an automotive fuel.

Hon'ble Supreme Court has mandated conversion of old vehicles to LPG/CNG in cities which are equally or more polluted than Delhi like Ahmedabad, Agra, Bangalore, Chennai, Hyderabad, Kanpur, Kolkata, Lucknow, Mumbai, Pune, Surat and Sholapur.

Public Sector Oil Companies had initially identified 228 Locations for setting up of Auto LPG Dispensing Stations in various Metros and some other major cities. However, in view of directive of the Hon'ble Supreme Court to oil marketing companies are at present primarily concentrating on increasing their infrastructure in above mentioned cities. As on 1st January, 2005, OMCs have commissioned 99 ALDS in 16 cities and

have planned another 60 ALDS to be commissioned in a phased manner.

Auto LPG pricing is market determined and there is no subsidy on Auto LPG. At present about 13 manufacturers of Conversion kits for 4 Wheeler vehicles and about 11 manufacturers of Conversion kits for 3 Wheeler vehicles have been approved by various Testing Agencies like ARAI Pune, VRDE Ahmednagar & IIP Dehradun.

PARALLEL MARKETING OF LPG.

In order to increase the availability of LPG and to foster competition, the private sector was allowed to participate in the scheme of parallel marketing of LPG in April 1993- by decanalising imports of LPG. Under the scheme, a private party can undertake import of LPG after obtaining a rating certificate from one of the approved rating agencies given in the LPG (Regulation of Supply and Distribution) Order, 2000. Under PMS LPG is to be sold at market-determined prices by the private parties. LPG imports during 2004-05 have been about 265.3 TMT against about 216.3 TMT during the last year.

Recently Government have authorized ONGC, GAIL & RIL to market their seasonally surplus LPG through parallel marketing system or directly. Likewise, Government have authorised RIL and MRPL to sell SKO directly at market price, after meeting PDS requirement projected by OMCs.

NOTE ON MARKETING OF TRANSPORTATION FUELS

As a consequence of dismantling the APM & allowing competition, Government have granted the authorisation to market transportation fuels in favour of new entrants namely; Oil and Natural Gas Corporation Limited (ONGC), Mangalore Refinery and Petrochemicals Limited (MRPL) & Numaligarh Refinery Limited (NRL) (All Public Sector Oil Companies) and M/s. Reliance Petroleum Limited(RIL), M/s. Essar Oil Limited(EOL) and M/s. Shell India Pvt. Ltd (SIMPL).

The details of the Retail Outlets being set up by new entrants is as under :

Name of Company	Number of Retail Outlets	Commissioned as on date.(17.2.2004)
ONGC	1,100	Nil
NRL	510	04
RIL	5,849	243
EOL	1,700	153
MRPL	500	Nil
SIMPL	2,000	Nil

The Retail Outlets would be set up by these companies as per their commercial considerations subject to the condition that they would set up at least 5.6% of the retail outlets in remote areas and at least 5.3% of their retails outlets in low service areas. Further they would abide by other marketing service obligations and retail service obligations as notified by the Government from time to time.

2. PROFILES OF COMPANIES :

A. Bharat Petroleum Corporation Ltd.

Bharat Petroleum Corporation (BPCL) traces its history to 1928 when the Burmah Shell Oil Storage & Distribution Company of India was incorporated in England to enter the petroleum products business in India. The business of the Company grew substantially given the international backing of Shell and it achieved the leadership position in India. In 1952, Shell and Burmah Oil Company set up Burmah Shell Refineries to set up a refinery in Mumbai. The entire operations of Burmah Shell in India were nationalised in 1976 and the Refinery and Marketing Companies were merged to form BPCL.

BPCL is India's second largest oil company in terms of market share and processes about 9 million metric tons of crude per year. Today the company produces a diverse range of products, from Petrochemicals and Solvents to aircraft fuel and speciality lubricants. It manufactures petroleum and petroleum products, asphalt, bituminous substances, carbon, carbon black, hydrocarbons, mineral substances and the products/by-products derived there from.

Its turnover was Rs 53,448 crores or US \$11,877.33 Million. The company's market sales including exports stands at 20.86 million tonnes and its market share is currently 22.05 percent of the petroleum products market.

The company produces a diverse range of products such as petroleum products, petrochemicals, and specialty lubricants at its refinery in Mumbai, which forms the backbone of the organization.

The organisation structure of BPCL was revamped and six new Strategic Business Units (SBU's) have been created. They are Refinery, Retail, Industrial & Commercial, Lubricants, Aviation. LPG. The new structure is based on business processes, is flexible, more responsive to external changes, has fewer layers, and above all, ensures a much higher customer focus.

During 2000-01 the company issued bonus shares in the ratio of 1:1, thereby enhancing its equity capital to Rs 300 crores. Currently BPC holds 54.81% in KRL and 62.96% in NRL. Government has a 66% stake in the company, which it plans to divest in due course of time. The contenders for the same include MNCs like Shell along with domestic companies like Reliance Industries. A possible cross holding between BCPL and HPCL is also proposed.

Refinery Modernization Project is being implemented at a cost of Rs.18,310 million . This project besides improve distillate yield and energy efficiency, will enhance the crude oil capacity to 12 MMTPA. The project is expected to be commissioned October,2004. Gas Turbine and Heat Recovery Steam Generator project was commissioned during 2001-02 at a cost of Rs.1750 million. The long term plan of setting up a 7 MMTPA capacity

grassroots refinery project in Allahabad District of UP is under final stage of approval. The forestland of 450 acres has been approved and the estimated cost of the Refinery project amounts to 61,800 million. This project is planned in such a way it should be mechanically completed within 48 months from the date of receipt of all statutory approvals.

Background	
Incorporation Year	1976
Registered Office	Bharat Bhavan, 4&6 Currimbhoy Rd Ballard Est., Mumbai - 400001, Maharashtra
Telephone	91 - 022 - 22713001-004
Fax	91 - 022 - 2616793/2642112
Industry	Refineries
House	GOI - BPCL
Chairman & Managing Director	Shri Ashok Sinha
Company Secretary	Shri D. M Naik Bengre
Auditor	M/s V Sankar Aiyar & Co
Face Value	10
Market Lot	1
Listing Stock Exchanges	Mumbai, Chennai, Delhi, Kolkata, and National Stock Exchange of India Ltd
Registered Office	Bharat Petroleum Corporation Ltd Bharat Bhavan, 4 & 6 Curimhoy Rd, Ballard Estate, Mumbai - 400 001

B. Hindustan Petroleum Corporation Ltd

1952 - The Company was incorporated in the name of Standard Vacuum Refining Company of India Limited on July 5, 1952 under the Indian Companies Act, VII of 1913.

1962 - On 31st March the name was changed to ESSO Standard Refining Company of India Limited.

1974 - On July 15th the name of the company was changed to its present name Hindustan Petroleum Corporation Limited., by virtue of Lube India and ESSO Standard Refining Company of India Limited Amalgamation Order 1974 dated July 12, passed by the Company Law Board, Department of Company Affairs, GOI, New Delhi and as published in the Gazette of India Extra-Ordinary GSR No.320(E) dated July 15. A certificate to this effect was issued by the Registrar of Companies, Mumbai on September 4th.

1976 - With the nationalisation of Caltex Undertakings in India the same were also taken over by the Government of India and subsequently merged with HPCL.

1979 - The undertakings of Kosangas Company Ltd. were merged with HPCL. As part of the disinvestment in PSUs, shares of HPCL were sold by the Government to Financial Institutions, Mutual Funds and Banks. Presently the Government holding in HPCL is 60.31%. The balance is being held by Financial

Institutions, Mutual Funds, Banks, Foreign Institutional Investors, Employees and Individual Shareholders.

- It has co-promoted several joint ventures like Mangalore Refinery & Petrochemicals (MRPL), Hindustan Colas, Petronet India, Punjab Refinery Project, Visakh Power Project, Prize Petroleum Co & South Asia LPG Co.

1983 - The capacity of lube plant was increased by an additional 74,000 tonnes per annum of high viscosity index lube base stocks.

1985 - The crude unit and related off-sites were commissioned in January and fluid catalytic cracking unit was commissioned in August.

- During the year corporation embarked upon a project to expand the crude distillation capacity at Mumbai by 2 million tonnes per annum at an estimated cost of Rs.45 crores. This project was commissioned in April.

1988 - Mangalore Refineries & Petrochemicals Ltd., is the first joint sector refinery being set up in the country after the Government has allowed entry of the private sector in the petroleum refining industry.

1989 - During the year corporation installed the latest C-generations concept 3*10 MW gas turbines to meet the power

requirement at Bombay Refinery with facilities to generate steam simultaneously.

1991 - During September 3*10 MW gas turbine generators and heat recovery steam generators were commissioned at a cost of Rs.79.22 crores at Mumbai.

1993 - During March an MOU was entered into between Govt. of India and Govt. of Sultanate of Oman, HPCL and Oman Oil Co., Ltd., for setting up 6 million TPA refinery on the West Coast of India through a joint venture company called Hindustan Oman Petroleum Co. Ltd.

1994 - In March 1993, an MOU was signed between the Government of India, HPCL, Government of Sultanate of Oman and Oman Oil Company to form a Joint Venture Company. Accordingly, on March 4, Hindustan Oman Petroleum Company Ltd. (HOPCL) was incorporated. The project is estimated to cost approx. Rs. 4426 crores (at June prices) and both promoters will have a 26% stake each in the equity. - A Memorandum of Understanding has been signed on May 24th between HPCL and Colas S.A., France for implementing a project for setting up a Bitumen Emulsions plant. This was followed by execution of the Joint Venture agreement on November 25th. It is proposed to form a Joint Venture Company (JVC) in the name of 'Hindustan Colas Limited' in the State of Maharashtra with equal equity participation from HPCL and Colas S.A., France.

- During the year, the company entered into a tie up with Exxon, a leading oil company for blending and marketing EESO brand of lubes.

1995 - During February, the company issued 173,50,000 equity shares of Rs.10 each with detachable warrants of Rs.380 each as follows.

- On firm allotment basis:
 - i) 34,70,000 equity shares with warrants to Indian Financial institutions
 - ii) 3,35,000 shares with warrants to Indian Mutual Funds.
- b. Preferential allotment basis:
 - i) 17,35,000 shares with warrants to share to employees
 - ii) 17,75,000 shares with warrants to shareholders of the company,
 - iii) 34,70,000 shares with warrants to NRIs, balance 66,05,000 shares were issued to the public.
- During the year company entered into a MOU with Saudi Arabian Oil Co.(Saudi Aramco) for setting up a 1 million tonnes p.a refinery Punjab. Aramco would contribute to the extent of 26% in the equity capital of the company.
- During the year company proposed to undertake petrochemical production from feedstock available from the refineries. The petrochemicals planned were paraxylene/PTA, polyisobutylene and acrylonitrile.
- During the same year the company undertook to provide thermal power from surplus heavy fuel oil. The proposed joint

venture is to set up 500 MW power plant an estimated cost of Rs.1865 crores.

1996 - During the year March a joint venture with Colas S.A of France, the company commenced its first State-of-the-art Bitumen emulsion Plant of 20,000 TPA capacity at Vashi, named Hindustan Coalas Ltd.

1997 - A new Terminal was commissioned at Kakinada with 30000 KL Tankage and allied facilities at a cost of Rs. 15.06 crores.

- Hindustan Petroleum Corporation Limited (HPCL) is contemplating setting up 30 more LPG bottling plants over the next five years.
- HPCL is converting the detachable warrant into equity shares of Rs.10 at a premium of Rs.330 per share. Through this conversion of warrant company is raising Rs.589.90 crore. The amount will be payable in four instalments of Rs 85 each payable over a period of one year.
- Each warrant is to be converted into one equity share at a price of Rs.340 a share. With the full conversion of warrants, the government of India holding HPCL's equity capital will be just over 51 per cent, ruling out further dilution in the company's capital in the near future.
- HPCL has signed an MoU with the government for the execution of four projects, the Vizag refinery expansion project, Vizag-Vijaywada pipeline project, diesel hydro de-sulphurisation projects at Mumbai and Vizag and Punjab refinery project.

- The ministry of petroleum and natural gas has set up an expert committee on 15th September, to enquire into the causes leading to the breakout of fire at HPCL's Vishakapatnam refining plant.
- The joint venture between Hindustan Petroleum Corporation Ltd and its former parent before nationalisation, Esso, is on slippery ground.
- Hindustan Petroleum Corporation Ltd signed a fuel supply agreement with a private firm which would set up a 100 MW liquid fuel based combined cycle power plant near Kengeri on the city outskirts.

1998 - Hindustan Petroleum Corporation Ltd (HPCL) has signed a commercial agreement with Kondapalli Power Corporation Ltd (KPCL) for the supply of naphtha for the latter's 355-MW combined cycle power generation unit at Kondapalli in Krishna district of Andhra Pradesh.

- Hindustan Petroleum Corporation Ltd (HPCL) has awarded the contract to build the refinery to South Korea's Hyundai Heavy Industries.
- Hindustan Petroleum Corporation (HPCL) is believed to have signed an agreement with Esso Mauritius for marketing the latter's range of lubricating oils here.
- Hindustan Petroleum Corporation Ltd (HPCL) has set up a joint venture company with domestic financial institutions (FIs) for oil and gas exploration both in the country and abroad.
- Hindustan Petroleum Corporation Limited has commissioned its state-of-the-art modern LPG filling plant at Usar, Alibagh.

- State owned Hindustan Petroleum Corporation's (HPCL) joint venture with Aditya Birla Group, Mangalore Refineries and Petrochemicals Ltd (MRPL), is keen to set up an independent marketing network.

1999 - American Express and Hindustan Petroleum Corporation has signed a memorandum of understanding (MoU) for card acceptance at various gas stations.

- Hindustan Petroleum Corporation Ltd (HPCL) and Gas Authority of India Ltd (GAIL) have entered into an agreement for setting up a liquefied petroleum gas (LPG) pipeline and infrastructure from Visakhapatnam to Secunderabad via Rajamundry and Vijayawada.
- The Foreign Investment Promotion Board (FIPB) has allowed the joint venture of Hindustan Petroleum Corporation (HPCL) and Total of France, to set up LNG terminals and venture into downstream activities such as marketing of petro-products, etc.
- Hindustan Petroleum Corporation Ltd (HPCL) is celebrating its silver jubilee year with "Shakti Utsavs" in major Indian cities.

2000 - Scheme of amalgamation of Industrial Perfumes Ltd. with the company is effective from 9th February, with retrospective effect from 1st January, 1999.

- The Company signed a confidentiality agreement with Totalfina of France to look at downstream areas, including retailing, once the domestic oil sector is opened up.
- The Company has decided to float a joint venture information technology company for its e-commerce and other internet based services foray.
- The Company will set up a Rs 2900 crore power project in Visakhapatnam as part of the company's diversification strategy.
- HPCL has signed a business initiative with internet service provider (ISP) Satyam Infoway Ltd. to set up more than 200 cyber cafes at its retail outlets across the country.
- Pepsi has entered its second cyberspace venture forging a tie-up with Satyam and the company as the official beverages supplier for their "Speednet project".
- Mangalore Refinery and Petrochemicals, the joint venture between Hindustan Petroleum Corporation and the AV Birla Group of companies, is all set to sign a memorandum of understanding with Kuwait Petroleum Corporation for joint efforts in the downstream sector.
- There was a fire blast in the Refinery at Malkapuram Near Visakhapatnam, on 17th August.
- India's largest private Internet Service Providers, Satyam Infoway and Hindustan Petroleum Corporation Ltd. have forged an alliance to set up cyber kiosks at various petrol pumps across the country.
- Hindustan Petroleum Corporation Ltd. has entered the Bangladesh lubricants market with a range of its diesel engine and motor oil.

- Hindustan Petroleum Corporation Ltd. along with ZIP Telecom, front-end operator of Hughes Ispat, will set up public access telephone booths at HPCL retail outlets across Maharashtra.
- The Company has set up two regional offices in Jamshedpur as part of its strategy to focus on improving services.
- A subsidiary company "Guru Gobind Singh Refineries" has been incorporated on Dec 2000. Land admeasuring approx. 2000 acres has been acquired.
- GOI is the major shareholder in the company with 51% stake.

2001 - Hindustan Petroleum Corporation Ltd. has introduced its smart card in Bangalore for the first time in the country.

2002 - Hindustan Petroleum Corporation Ltd has informed that the Government of India has appointed Shri Arun Balakrishnan as Director-Human Resources of the Corporation.

- M B Lal appointed as Chairman & M D of HPCL.
- Hindustan Petroleum Corporation Ltd has informed that Shri Naresh Narad, Special Secretary, Ministry of Petroleum & Natural Gas has ceased to be a part time ex-officio Director of the Corporation with effect from November 11, 2002 consequent upon his movement from Ministry of Petroleum & Natural Gas, as Secretary, Ministry of Heavy Industries & Public Enterprises.
- M S Srinivasan appointed as part-time ex-officio Director on the Board of HPCL.

- Hindustan Petroleum Corporation Ltd has informed that Shri S D Gupta, Director (Finance) of the corporation passed away on December 26, 2002 after a brief illness.
- Approves Mangalore Refinery & Petrochemicals Ltd. (MRPL) control to Birlas
- HPCL is introducing a new system at its 6,000-odd retail outlets across the country. The Company plans to set up facilities enabling customers to buy original spare parts and accessories for the car
- Ties-up with Gas Authority of India Ltd (Gail), Oil and Natural Gas Corporation (ONGC) to purchase LPG
- Ties up with Lubrizol for its own brand of high-performance petrol, branded 'Power'
- Unveils branded petrol, diesel (Power & Turbojet respectively)
- HP unveils new retail brand - 'Club HP' through which it intends to offer quality personalised vehicle and consumer care through select outlets
- FedEx inks one-year agreement with HPCL to set up transportation services at HPCL's 100 "Club HP" retail outlets in eight cities in the country
- HPCL and GAIL sign agreement for formation of new JV Company to distribute and market environmentally friendly fuels in and around the cities of Andhra Pradesh

2003 - Cabinet Committee on Disinvestment (CCD) decides to divest 34.01 per cent equity in Hindustan Petroleum Corporation Ltd (HPCL) to a strategic partner

- Govt fixes Rs 2,500-cr net worth for HPCL bidders

- Forges alliance with Chennai-based KwickTel Communications to launch vehicle tracking system
- HPCL shareholding in Mangalore Refinery and Petrochemicals Ltd (MRPL) dips to 16.89% consequent to MRPL Debt Restructuring Arrangement
- TotalFinaElf withdraws from the race for acquiring the 34 per cent stake in Hindustan Petroleum Corporation Ltd (HPCL)
- HPCL becomes the second largest firm in terms of sales with a turnover of over Rs 50,000 crore
- Launches loyalty Plan for its LPG Consumers
- Launches a new scheme where in the LPG (liquefied petroleum gas) delivery boys will carry portable weighing scales, so that HP customer can measure the Gas content in cylinder before receiving it
- Unveils a high-octane petrol brand in the market named as 'Power '93'
- Ties up with Chevron for Aviation Turbine Fuel (ATF) business
- Government of India appoints Mr. C Ramulu as Director - Finance of the Corporation
- Signs agreement with Oil & Natural Gas Corporation (ONGC) for sourcing crude oil
- HPCL bags eighth slot among 'Top 10' in Asiamoney's corporate governance poll on Asian companies in the energy sector. And joined the club of a select few Asian companies.
- Unveils Smart Card which a customer could use to pay for petrol or diesel bought at HPCL's outlets

2004 -HPCL - Marketing Initiatives in Sri Lanka

- Hindustan Petroleum Corporation Ltd (HPCL) has formed a 50:50 joint venture with Total Gas and Power India (TGPI), a wholly-owned subsidiary of Total France, to develop the biggest underground 'Cavern LPG Storage' project at Visakhapatnam
- -Gets award for industrial safety by National Safety Council, Kerala Chapter in chemical industries sector
- Inks pact with Shell India Private Ltd for product and infrastructure sharing between the two companies
- Signs agreement with US Pizza, a pizza outlet, which would be opening over 500 delivery units at HPCL's outlets around the country. The understanding is aimed at making the partnership the largest food chain in the country
- Mr S. Roy Choudhary has been appointed as Director-Marketing in Hindustan Petroleum Corporation Ltd (HPCL), effective May 10
- Hindustan Petroleum Corporation Ltd on June 26 signed a memorandum of understanding with Indian Oil Corporation Ltd
- Birla Power Solutions, a Yash Birla Group company, has tied up with Hindustan Petroleum Corp Ltd (HPCL) to produce electricity generators, which run on LPG
- HPCL launches unique smart card
- Hindustan Petroleum Corporation signs MoU & Confidentiality agreement with Chevron Texaco

2005 -HPCL signs MoU with RCF (Rashtriya Chemicals Fertilisers Ltd)

- HPCL ropes in Sania Mirza to endorse retail brands
- Pizza Corner forges alliance with HPCL
- Amex, HPCL unveils co-branded credit card
- HPCL opens new LPG bunk in Visakhapatnam
- HPCL partners with MSFCL for bio-diesel venture
- HPCL signed an agreement with BP plc (formerly known as British Petroleum) to form 50:50 strategic joint venture partnership
- HPCL signs MoU with Gail on November 16, 2005

C. Indian Oil Corporation Ltd

1958 - Indian Refineries Ltd. was formed with Mr Feroze Gandhi as Chairman.

1959 - Indian Oil Company Ltd. was established on 30th June 1959 with Mr S. Nijalingappa as the first Chairman.

1960 - Agreement for supply of SKO and HSD was signed with the then USSR. M.V: "Uzhgorod" carrying the first parcel of 11,390 tonnes of HSD docked at Pir Pau Jetty in Mumbai on 17th August 1960.

1962 - Guwahati Refinery was inaugurated by Pt. Jawaharlal Nehru. Construction of Barauni Refinery commenced.

1963 - Foundation was laid for Gujarat Refinery , Indian Oil Blending Ltd. (a 50:50 Joint Venture between Indian Oil and Mobil) was formed.

1964 - Indian Oil Corporation Ltd. was born on 1st September, 1964 with the merger of Indian Refineries Ltd. with Indian Oil Company Ltd, Barauni Refinery was commissioned, The first petroleum product pipeline from Guwahati to Siliguri (GSPL) was commissioned.

1965 - Gujarat Refinery was inaugurated by Dr. S.Radhakrishnan, the then President of India, Barauni-Kanpur Pipeline (BKPL) and Koyali- Ahmedabad product Pipeline (KAPL)

commissioned, IndianOilPeople maintained the vital supply of Petroleum products to Defence in 1965 War.

1966 - The first long-term agreement was signed for harmonious employee relations.

1967 - Haldia Baraurii Pipeline (HBPL) was commissioned. Bitumen and Marine Bunker business began.

1968 - Techno-economic studies for Haldia-Calcutta, Bombay-Pune and Bombay-Manmad Pipelines submitted to the Government.

1969 - Indian Oil undertook the marketing of Madras Refinery products.

1970 - Indian Oil acquired 60% majority shares of IBP, The same was offloaded in favour of the President of India under a Directive in 1972.

1971 -Dealership/reservation was extended to war widows, disabled Defence personnel, Freedom Fighters, etc. after 1971 War.

1972 - R&D Centre was established at Faridabad, **SERVO**, the first indigenous lubricant was launched.

1973 - Foundation-stone of Mathura Refinery was laid by Mrs Indira Gandhi, the then Prime Minister of India.

- 1974 - Indian Oil Blending Ltd. (IOBL) became the wholly owned subsidiary of IndianOil, Marketing Division attained a new watershed with a market participation of 64.2%.
- 1975 - Haldia Refinery was commissioned, Multipurpose Distribution Centres were introduced at 132 Retail Outlets pioneering rural convenience.
- 1976 - Private petroleum companies nationalized, Burmah Shell became BPC.
- 1977 - R&D Centre launched Nutan wick stove.
- 1978 - Phase-wise commissioning of Salaya-Mathura Crude Oil Pipeline (SMPL) began.
- 1979 - Barauni Refinery and Bongaigaon Refinery and Petrochemicals Ltd. (BRPL) affected by Assam agitation.
- 1980 - The second Oil Shock was witnessed as a result of Iranian Revolution. Crude Oil price flared to a new high of \$32 per barrel.
- 1981 - Digboi Refinery and Assam Oil Company's (AOC) marketing operations were vested in IndianOil. It became Assam Oil Division (AOD) of IndianOil.

1982 - Mathura Refinery was commissioned, Mathura-Jalandhar Pipeline (MJPL) was commissioned.

1983 - Massive augmentation of LPG storage and distribution facilities were undertaken, Proposal for the 6 MMTPA Refinery at Karnal was submitted at an estimated cost of Rs 1,181 Crore.

1984 - Taluka Kerosene Depots (TKOs) were commissioned for improved availability of kerosene in rural and hilly areas in addition to Multipurpose Distribution Centres, Foreshore terminal at Kandla Port was commissioned, Integrated Corporate Planning -ten year Perspective Plan and five year LRP initiated.

1985 - The new office complex for the Registered Office of the Corporation and Head Office of Marketing Division with a total area of 23,110 square metres was completed, Additional Coking Unit at Barauni Refinery commissioned.

1986- A new Foreshore Terminal at Madras commissioned.

1987- Test marketing of 5 kg. LPG cylinders began in 1986-87 in Garo Hills and Kumaon.

1988 - DFR of Karnal (Panipat) Refinery was submitted to the Government of India.

1989- Salaya-Mathura Pipeline (SMPL) was suitably modified for handling Bombay High Crude during winter.

- 1990-** Kandla-Bhatinda Pipeline (KBPL) project was approved, The first LPG Bottling Plant of Assam Oil Division (AOD) at Silcher was commissioned.
- 1991-** Digboi Refinery Modernisation project was initiated, Bunkering facility at Paradip was completed.
- 1992 -** Revamp of Vacuum Distillation Unit at Mathura Refinery was completed, Two of the Indian Oil Table Tennis players represented the nation at Barcelona Olympic Games.
- 1993 -** New era of Micro-processor based Distributed Digital Control System (DDCS) replacing the pneumatic instrumentations began in Refineries, in phased manner.
- 1994-** India's First Hydrocracker Unit was commissioned at Gujarat Refinery, Vision-2000, the Retail Visual Identity programme was launched to upgrade facilities at Retail Outlets.
- 1995-** 1,443 km. long Kandla-Bhatinda Pipeline (KBPL) was commissioned at Sanganer, The Indane Home Shoppe was launched.
- 1996 -** State-of-the-art LPG Import Terminal at Kandla with a capacity of 6,00,000 tonnes per annum was commissioned, 1 million metric tonne per annum (MMTPA) new CDU at Haldia Refinery was executed with in-house supervision, The first batch of one year International MBA (iMBA) programme was

successfully conducted by Indian Oil Institute of Petroleum Management (IIPM).

1997 - Commercial production of SERVOLL Titex Grease commenced at the world's first Titex Plant at Vashi, Bombay, Business Development received new thrust, Indian Oil entered into LNG business through Petronet LNG -a JV company.

1998 - Panipat Refinery was commissioned, Haldia, Barauni Crude Oil Pipeline (HBCPL) was completed, The Administrative Pricing Mechanism (APM) was withdrawn from the Refining Sector effective 1st April 1998. Phase-wise dismantling of APM began, Indian Oil Board was reconstituted under the Navaratna concept, with the induction of five part-time non-official independent Directors.

1999 - Indian Hydrocarbon Vision -2025" was announced at PETROTECH-99, organised by Indian Oil on behalf of the oil Industry, India attained self-sufficiency in Refining, Diesel Hydro-desulphurisation Units commissioned at Gujarat, Panipat, Mathura and Haldia Refineries, Manthan -- the IT re-engineering project was launched.

2000 - Indian Oil crossed the turnover of the magical mark of Rs 1,00,000 Crore -- the first Corporate in India to do so, The Indian Oil Foundation -- a non-profit trust -- the first of its kind in Corporate India, was unveiled to protect, preserve and promote the country's heritage, Y2K compatibility achieved, JNPT Terminal was commissioned, The Lube Blending Plant at Asoti

and the Once through Hydrocracker Unit at Mathura refinery were commissioned, Indian Oil entered into Exploration & Production (E&P) with the award of two exploration blocks to Indian Oil and ONGC consortium under NELP-I.

2001 - Digboi Refinery completed 100 years of continuous operation, Chennai Petroleum Corporation Ltd. (CPCL) and Bongaigaon Refinery and Petrochemicals Ltd. (BRPL) were acquired, Fluidised Catalytic Cracker Unit at Haldia Refinery was commissioned, Augmentation of Kandla-Bhatinda Pipeline (KBPL) to 8.8 MMTPA completed, Eight Exploration blocks awarded to the IndianOilled consortium under NELP-II, Two Coal Bed Methane (CBM) blocks awarded to the consortium of Indian Oil and ONGC under CBM-I, The investment proposal for Integrated PX/PfA project at Panipat was approved.

2002 - APM dismantled. Pricing of Petroleum products decontrolled, IBP Co. Ltd. was acquired with management control, Barauni Refinery expansion project completed, New generation auto fuels IOC Premium and Diesel Super introduced.

2003 - Lanka IOC Pvt. Ltd. (LIOC) launched in Sri Lanka, Retail operations began in Sri Lanka. Indian Oil became the first Indian Petroleum Company to begin downstream marketing operations in overseas market. Lanka IOC became an independent oil company in Sri Lanka, Gasahol, 5% ethanol blended petrol, was introduced in select states, INDMAX unit at Guwahati Refinery commissioned, Indian Oil Technologies Ltd. for marketing intellectual properties of R&D centre was launched, Foundation

Stone of Panipat Refinery Expansion and PX/PTA projects laid, Maiden LPG supplies to Port Blair, KVSPL (Product) Pipeline commissioned, Concept of XTRA, covering Retail Outlets and customer service, launched, SERVO became a Super Brand, Indian Oil named as nodal agency by MoP&NG to undertake research in the areas of production, storage, distribution and utilisation of hydrogen gas as an alternative fuel, The foundation stone of IndianOil's Panipat Refinery expansion (6 to 12 MMTPA) project and PX/PTA plant (553 TMTPA) project laid at Panipat.

2004 - Indian Oil turned a Gas marketer by sale of regasified LNG, Indian Oil Mauritius Ltd.'s 18 TMT state-of-the-art Oil Storage Terminal at Mer Rouge commissioned

➤ **2004-** Lanka IOC Pvt. Ltd. (LIOC) launched in Sri Lanka, Retail operations began in Sri Lanka. Indian Oil became the first Indian Petroleum Company to begin downstream marketing operations in overseas market. Lanka IOC became an independent oil company in Sri Lanka, Gasahol, 5% ethanol blended petrol, was introduced in select states, INDMAX unit at Guwahati Refinery commissioned, Indian Oil Technologies Ltd. for marketing intellectual properties of R&D centre was launched, Foundation Stone of Panipat Refinery Expansion and PX/PTA projects laid, Maiden LPG supplies to Port Blair, KVSPL (Product) Pipeline commissioned, Concept of XTRA, covering Retail Outlets and customer service, launched, SERVO became a Super Brand, Indian Oil Board approves merger of subsidiary IBP with parent company Indian Oil in May, Indian Oil Mauritius (IOML) terminal

inaugurated, Indian Oil became the only oil PSU in the country to adopt instruments of risk management in international trading and commerce, derivatives trading to protect refining margins, Indian Oil pays the highest-ever dividend of 20% (for fiscal 2003), amounting to Rs 2453 crore, to shareholders, Indian Oil signs MoU with IIM (Ahmedabad) to offer one-year Post Graduate Programmes in Management (Energy) to be conducted at IIPM, Gurgaon, Indian Oil signs MoU with Haryana government to set up the Rs 6300 crore Naptha Cracker & Polymer Complex at Panipat, R & D Centre bags the prestigious National Technology Award for successful commercialisation of INDMAX technology for conversion of low value heavy petroleum residues into high value LPG, Indian Oil moves up by two places to the 189th position in the Fortune 'Global 500' ranking based on fiscal 2003 performance.

IndianOil's Rs 1248 crore LAB (Linear Alkyl Benzene) plant, the world's largest single train kerosene-to-LAB unit, was commissioned at Gujarat, thus signalling IndianOil's entry into petrochemicals business.

- IndianOil signs Memorandum of Collaboration (MoC) with Mahindra & Mahindra to roll out the country's first hydrogen vehicle in the next two years.
- Indian Oil's 60 km-long Rs 76 crore Panipat Rewari Product Pipeline commissioned.
- Indian Oil signs MoU with Nepal Oil Corporation Limited to lay a product pipeline between Raxaul (India) and Amlekhganj (Nepal).

- The year marked IndianOil's entry into gas business. As co-promoter of Petronet LNG Limited, complete quantity of gas (2.52 MMSCMD) allotted to Indian Oil was sold out and commercial supplies commenced April 2004 onwards.
- Indian Oil was voted as the most trusted petrol pump brand in the country in a survey of India's most trusted brands conducted by the Economic Times Brand Equity.
- LIOC (Lanka IOC), IndianOil's subsidiary, created history on the Colombo stock exchange as the biggest ever equity issue. LIOC's IPO offering 25% stake was oversubscribed 11.6 times on the first day itself.

2005 - The year marked IndianOil's big ticket entry into the high stakes business of E&P. The Indian Oil and Oil India consortium signed its Exploration and Production Sharing Agreement (EPSA) with the National Oil Corporation of Libya for Block No. 86, in the Sirte basin of Libya.

- IndianOil's Mathura Refinery was the first refinery in India to attain the capability of producing entire quantity of Euro-III compliant diesel by commissioning the Rs 1046 crore DHDT (Diesel hydrotreating unit). Mathura Refineries also commissioned India's first MS quantity upgradation unit to produce Euro-III compliant petrol.
- Indian Oil becomes the top oil trading company amongst national oil companies in the Asia Pacific region for the second consecutive year.

- Indian Oil signs a Supply Purchase Agreement (SPA) to procure 1.75 MMTPA LNG to be received by the last quarter of 2009 at Petronet LNG Limited Dahej terminal.
- Indian Oil breached the Rs 150, 000 crore mark in sales turnover by clocking Rs 150, 677 in turnover in fiscal 2004.
- Indian Oil signed a JV agreement with GAIL to enter the city gas distribution projects in Agra and Lucknow.
- Indian Oil allowed by Government of India to charter crude oil ships on its own instead of going through Transchart, the chartering wing of the Ministry of Shipping.

India's Downstream Major

The Indian Oil Group of companies owns and operates 10 of India's 18 refineries with a combined refining capacity of 54.20 million tonnes per annum (1 million barrels per day). These include two refineries of subsidiary Chennai Petroleum Corporation Ltd. (CPCL) and one of Bongaigaon Refinery and Petrochemicals Limited (BRPL). Indian Oil owns and operates the country's largest network of cross-country crude oil and product pipelines spanning nearly 9,000 kilometres, with a combined capacity of 60.42 MMTPA.

Indian Oil and its subsidiaries account for 56% petroleum products market share among public sector oil companies, 42% national refining capacity and 69% downstream pipeline throughput capacity.

For the year 2004-05, Indian Oil sold 50.13 million tonnes of petroleum products, including 1.96 million tonnes through exports.

To maintain its competitive edge and leadership status, Indian Oil is investing Rs. 24,000 crore (US \$ 5.6 billion) during the X Plan Period

(2002-07) in integration and diversification projects, besides refining and pipeline capacity augmentation, product quality upgradation and retail expansion.

Network Beyond Compare

As the flag-ship national oil company, Indian Oil's countrywide network of 24,000 sales points is backed for supplies by 158 bulk storage depots and terminals, 95 aviation fuel stations and 88 Indian LPG bottling plants. Its subsidiary, IBP Co. Ltd., is a stand-alone marketing company with a nationwide network of nearly 4000 retail sales points.

Indian Oil reaches Indian cooking gas to the doorsteps of 41.05 million households in 2,353 markets through a network of nearly 4,700 Indian distributors.

Indian Oil also operates the largest and the widest network of retail outlets (petrol/diesel stations) in the country. A significant milestone was achieved with the commissioning of the company's 10,000th petrol station during the year 2004-05. Indian Oil's SERVO brand lubricants, being the first and only one in its category in India to be accorded 'Super brand' status, is the country's leading, with over 42% market share and 450 grades. *SERVO* lubricants are sold through over 10,000 Company retail outlets, besides a countrywide network of bazaar traders.

Indian Oil's ISO-9002 certified Aviation Service commands a 65% market share in aviation fuel business, meeting the fuel needs of domestic and international flag carriers, private airlines and the Indian Defence Services.

Customer First

At Indian Oil, customer is the first priority. During 2004-05, a slew of initiatives were launched for the convenience and benefit of the various customer segments. Branded auto-fuels (**XtraPremium petrol and Xtra Mile diesel**) market was expanded to cover more retail outlets across the country. Exclusive **Xtra Care** retail outlets were unveiled in select urban and semi-urban markets during the year 2004-05, offering a range of services to enhance customer delight and loyalty.

Similarly, to meet the discerning needs of highway motorists, large format **Swagat** brand retail outlets were launched during the year with multiple facilities such as food courts, first aid, dormitories for drivers and cleaners, repair and spare part shops etc..

Specially formatted retail outlets - Kisan Sewa Kendras – were also launched during the year 2004-05 to meet the diverse needs of rural customers were launched during the year. These outlets were strategically positioned to offer product and services such as fertilizers, seeds, pesticides, farm equipment, medicines, spare parts for trucks and tractors, tractor engine oils and pump set oils besides auto fuels and kerosene.

R&D for Growth

Indian Oil's world class **R&D Centre** is perhaps Asia's finest. Besides pioneering work in lubricants formulation, refinery processes, pipeline transportation and alternative fuels such as bio-diesel, the Centre is also the nodal agency of the Indian hydrocarbon sector for ushering in Hydrogen fuel in the country.

Expanding Horizons

Indian Oil has set its sight to reach US\$ 60 billion revenues by the year 2010-11 from current earnings of US\$ 34.44 billion. The road map to attain this milestone has been laid through vertical integration – forward into petrochemicals and backwards into exploration and production of crude oil, besides diversification into natural gas business and globalization of our operations.

In petrochemicals, a master plan envisaging Rs. 25,000 crore (US\$ 5.7 billion) investment is already underway. The commissioning of the world's largest single train Linear Alkyl Benzene plant at Koyali refinery in August 2004 and the on-going integrated Paraxylene/Purified Terephthalic Acid (PX/PTA) plant and a world-scale Naphtha Cracker with downstream polymer projects are part of this plan. Indian Oil also proposes to convert the on-going Paradip refinery into a refinery-cum-petrochemicals complex to strengthen its presence in the sector.

In exploration & production (E&P), Indian Oil has participated in the first three rounds of NELP (New Exploration Licensing Policy) in India, in consortium with other companies, and was awarded 11 exploration blocks. It has acquired participating interest in on-shore blocks in Assam and Arunachal Pradesh region. Overseas ventures include 2 blocks in Sirte Basin in Libya and Farsi Exploration Block in Iran. The Corporation is also exploring opportunities to acquire a suitable medium-sized E&P company to quickly consolidate its upstream operations.

In natural gas business, Indian Oil is already marketing 5.26 MMSCMD

(million metric standard cubic metres per day) of gas. To augment its business in the sector, it has now finalized an import deal for 1.75 million tones of LNG per annum with Iran for supplies from the year 2009 onwards. The Corporation has also proposed partnering Petropars, a subsidiary of National Iranian Oil Company, in jointly developing gas blocks in the North Pars fields of Iran.

Indian Oil grossed its first US\$ 1 billion in revenues through initiatives in new business in 2004-05.

Transnational Presence

To emerge as a transnational energy major, Indian Oil has set up offices in Sri Lanka, Mauritius and UAE and is simultaneously scouting new opportunities in new energy markets in Asia and Africa.

The Sri Lankan subsidiary, Lanka IOC, operates 170 retail outlets commanding a 27% market share. Its oil terminal at Trincomalee is also Sri Lanka's largest petroleum storage facility.

Indian Oil Mauritius Ltd. has garnered a 7% market share in the very first year of its operation. It also operates a modern petroleum bulk storage terminal at Mer Rouge port, besides five retail outlets. A modern product testing laboratory and expansion of retail network have also been proposed in Mauritius.

Indian Oil's Regional Office in Dubai, which is coordinating business expansion in the Middle East, has commenced blending of SERVO lubricants through contract blending arrangements for the first time recently.

Synergy through Subsidiaries

A wholly owned subsidiary Indian Oil Technologies Ltd., has been established for commercializing the innovations and technologies developed by the R&D Centre across the globe. The merger of Indian Oil Blending Ltd with the parent company, now approved by the Government, is in the final stages of implementation.

The merger of IBP Co. Ltd., a retail focussed subsidiary with a network of 4,000 retail outlets, with the parent company is awaiting the Government's nod after its approval by the Boards of Indian Oil and IBP. On Government's approval, other statutory approvals, including shareholder's approval, would be sought to complete the merger at the earliest.

The merger of Bongaigaon Refinery and Petrochemicals Ltd. with the parent company has also been mooted with the respective Boards approving the same already. Other formalities, including Government's nod, would be sought in due course.

Spreading Wings

The Corporation has launched several joint ventures in partnership with some of the most respected Corporates from India and abroad -- Lubrizol, Nyco SA, Petronas, Oiltanking GmbH, Marubeni, to name a few. SERVO lubricants are being marketed in Dubai, Nepal, Bhutan, Kuwait, Malaysia, Bahrain, Indonesia, Sri Lanka, Kyrgyzstan, Mauritius, Bangladesh, etc.

Indian Oil has been lending its expertise for nearly two decades to various countries in several areas of refining, marketing, transportation,

training and research & development. These include Sri Lanka, Kuwait, Bahrain, Iraq, Abu Dhabi, Tanzania, Ethiopia, Algeria, Nigeria, Nepal, Bhutan, Maldives, Malaysia, Sudan and Zambia.

Indian Oil's sincere commitment to Quality, Safety, Health and Environment is reflected in the series of national and international certifications and awards earned over the years.

The 18th largest petroleum Company in the world, Indian Oil is well on its way to becoming an integrated, transnational energy corporate.

3. BUSINESS ACTIVITIES

3.1 Bharat Petroleum Corporation Ltd :

REFINERIES :

Bharat Petroleum's Mumbai (Mahul) Refinery (BPCR)

(BPCR) is one of the most versatile Refineries in India and excels in all aspects like quality, technology, fuel & loss, human relations, safety, environmental friendliness and operating cost. With successful implementation of various projects and de-bottlenecking, the Refinery currently processes about 9 Million Metric Tons of crude oil per annum. BPCR has processed 61 different types of crude in five decades of its operations, making it one of the most flexible Refineries in the country. The Refinery uses latest microprocessor based Digital Distributed Control System (DDCS) and has been accredited with ISO 9002 (Quality Management System), the refinery laboratory has also been accredited with the unique distinction of a quality certification from NABL for "Quality Assurance Laboratory".

It is the first Indian work site to achieve a Level 8 rating on the International Safety Rating System (ISRS). ISRS is a tool owned by Det Norske Veritas, UK for comparison benchmarking and development of safety management systems worldwide. ISO 14001 (Environmental Management System) certifications has also been conferred to BPCR for effective deployment of environmental care measures.

Refinery Modernisation Project (RMP)

(RMP) is being implemented and is expected to be completed during 2004. State of the art hydro cracker being implemented under this project would help in producing products meeting the Euro III/Euro IV quality norms. Additionally, the project will also enhance crude processing capacity of the Refinery to 12 MMTPA.

International Trade and Shipping (IT&S)

(IT&S) is an integral part of Mumbai Refinery and is fully equipped to import and export petroleum products, it caters to crude oil acquisition (both indigenous and imported). In addition it also handles the logistics by chartering of vessels for both crude and products,

Corporate R&D Centre (CRDC)

(CRDC) set up at NOIDA near Delhi with state-of-the-art facilities is backed with a vision to develop high value products, services, processes & technologies and create innovative R&D solutions to earn customer's delight. Phase – 1 of the new Corporate R&D center has been set-up at a cost of Rs 780 Millions. The Department of Scientific & Industrial Research, Government of India, recognizes BPCL's in-house R&D center- CRDC.

Subsidiaries

Bharat Petroleum holds 66.04% shares in Kochi Refineries Limited (KRL). KRL with a refining capacity of 7.5 MMTPA has been achieving a capacity utilization of over 100% for the last few years.

Bharat Petroleum has the controlling stake in its other subsidiary, Numaligarh Refinery Limited (NRL) with 62.9% of paid up equity. The 3 MMTPA Numaligarh Refinery is designed to maximize production of middle distillates (kerosene and diesel).

RETAIL :

Ensuring you reach your destination - Swiftly & conveniently.

The Retail SBU represents the face of Bharat Petroleum to the outside world and is engaged in the retailing of Petrol, Diesel and Kerosene, besides various Non-Fuel Products and value-added services through its robust network of 6553 retail outlets and 1007 Kerosene dealers.

Viewing the impending deregulation more as an opportunity rather than a threat, substantial steps were undertaken to maintain the lead and create a distinct product differentiation vis-à-vis competition. This customer-oriented approach is evident from the various offerings at Bharat Petroleum's Retail Outlets. At present, Bharat Petroleum enjoys a market share of 30.2% in Petrol and 26.4% in Diesel. Also, the average fuel sales per Retail Outlet at 167KL (Kilolitres) per month are significantly higher than the Industry average subtly indicating Bharat Petroleum's state of preparedness.

Bharat Petroleum's Retail SBU is working towards increasing the economic value of the existing Retail Outlets. Besides building a leadership position in the fuels business, Bharat Petroleum also aspires to build a niche for itself in the non-fuel segment. In consultation with the leading international consultants McKinsey &

Co., the retail SBU has chalked out a strategy focussed on building stronger ties with the customers and leveraging the large national network to realise greater economic value.

This customer-oriented approach is manifested in the various pioneering offerings at Bharat Petroleum's Retail Outlets. For more details, select the desired link above.

LPG :

Bharatgas-"Adding more flavour to your life"

Millions of Indians wake up each morning with "the cup that cheers" prepared on Bharatgas (LPG - cooking gas). Similarly, hundreds of commercial and industrial establishments start their day, confident and secure, having entrusted their Bharatgas needs to Bharat Petroleum.

	Oneers		Network
	Service		Commitment to Safety
	New Horizons		

Pioneers

Way back in 1928, Multinationals Asiatic Petroleum (India) and Burmah Oil Company joined hands to form the Burmah-Shell Oil Storage and Distribution Co. of India Ltd., a company which dominated the oil market in India for decades to come.

A pioneer in more ways than one, Burmah-Shell was the first to introduce LPG as a cooking fuel in the Indian homes in 1954-55. Its users fondly remember the pioneering brand, 'Burshane' even today. With nationalization in 1976, Burmah Shell became Bharat Petroleum and 'Burshane' was renamed '**Bharatgas**'.

Since June 1998, LPG has now become one of the Strategic Business Units of Bharat Petroleum Corporation Ltd. specifically looking after over 21 million Domestic Customers and thousands of Industrial & Commercial Customers. The focus of the LPG Business Unit is "Customer Delight" and "Safety".

Network

The Corporation meets its LPG customers' needs through its huge infrastructure and dedicated team of people. An All India network of over 2061 **Distributors** and more than 46 **LPG Territory Offices** helps ensure that customer focus is uppermost in mind.

Bharat Petroleum's huge infrastructure and wide network of Bharatgas Distributors, which is spread across the country, is its strength in meeting customer needs.

A Bharatgas distributorship operates for a given geographical area, within which the customers can be conveniently serviced to their satisfaction.

The Distributors provide home delivery service of LPG refills as and when the customers book their refills. Mechanic services are also provided to customers during the office hours on all working days.

Mechanic service is free for any leakage complaint pertaining to the cylinder and pressure regulator provided to the customer by the Bharatgas Distributor.

Service

Bharat Petroleum's commitment to deliver high quality service to its Bharatgas customers is reflected in the number of customer-oriented initiatives that have been undertaken.

Special emphasis is laid on training the distributors and their staff for providing customer assistance promptly and with a smile on their faces. **Customer Relations Centres**, which provide customers a forum for giving feedback and for obtaining clarifications/other assistance on all LPG related matters, have been set up across the country.

Keeping pace with the electronic revolution, Bharat Petroleum has taken the lead in computerizing Bharatgas distributorship operations with the help of a software package developed in-house.

Distributors in metros and major towns have been provided with pagers, **IVRS** (Interactive Voice Recording System) / Voice-Mail service, online booking through www.ebharatgas.com etc. for enabling 24-hour refill booking by Bharatgas customers.

Commitment to Safety

Bharat Petroleum continues to accord the highest priority to safety of LPG customers. Regular Safety Clinics are conducted to educate customers on safe use of LPG and conservation of fuel.

In addition, safety and conservation messages are communicated to LPG users through the print and audio-visual media. **Emergency Service Cells/Bharatgas Helplines** have been put in place to attend to LPG leakage complaints after Distributor's working hours and on holidays.

New Horizons

The LPG Business Unit has also initiated various steps in marketing of LPG through new channels of trade. Cash & Carry Delivery Counters have been commissioned at some Bharat Petroleum's Bottling Plants to benefit the local population.

The Rural Marketing Vehicle (RMV) has been launched to go into rural markets and fill cylinders on the spot. Presently 24 such Rural Marketing Vehicles have been deployed in the rural areas of various States. The first ever Auto LPG Dispensing Station (ALDS) of a PSU oil company was commissioned in Delhi by Bharat Petroleum. Presently there are 25 Auto LPG Dispensing Stations operated by BPC.

Supply of LPG through pipeline to households is fast growing. Bharatgas has the privilege of providing this service to various mega mega housing complexes across the country.

LUBRICANTS :

In line with the economic liberalisation in India, Lubricants was the first downstream Petroleum product to be totally deregulated with effect from 1991. Since then a large number of players - National,

MNCs as well as Global Players - have entered the Indian Lubricants market. Despite operating in a totally competitive environment, BPCL's Lubricants SBU has been registering a growth in lubricant sales continuously over the past couple of years. In 1999 - 2000, an overall growth of 5.3% has been registered, with a healthy turnover of Rs. 5.03 billion.

BPCL's Lubricants SBU, which operates in a totally competitive environment, has been registering a growth in lubricant sales continuously over the past couple of years. This has mainly been due to the formation of a separate business unit, which has enabled the staff to work with undivided attention on the lubricant business.

The Lube Plants at Wadilube (Mumbai), Budge Budge (Calcutta), Shakurbasti (Delhi) and Tondiarpet (Chennai) have organised themselves as close-knit teams to maximise levels of production and despatch. The Plant at Wadilube has successfully completed its 4th Surveillance Audit of ISO 9002. As part of the ongoing improvements in packaging, the new series of packages developed entirely in-house have been introduced.

To support the business initiatives, a major thrust has been given to improving BPCL's product offering and increase its market presence. The new R&D Center at Sewree, Mumbai, has developed a number of new products in the automotive and industrial categories. Towards higher visibility, substantial investments have been made in revitalising the brands through product quality and package improvements. The entire distribution system has been revamped to ensure that products are more conveniently available and

distinctively visible in the market price. Exclusive branded Lube Shoppe's have been opened all over the country to improve our reach, as well as many innovative & unconventional methods are being used to create brand awareness especially in the diesel oils segments.

BPCL is confident that it will continue to make substantial and sustained efforts with appropriate investments, synergise business between channels, improve quality and quantity standards, invest in R&D for new product development and aggressively build the brands to result in maximising the value addition for both the business and its customers.

Automotive lubricant:

Lubricants play a very vital role in the smooth & trouble free operation of any automobiles. There are different accretes fitted in an automobiles vehicle such as engines, gear & transmission, brake system, radiator coolant , wheel bearing etc requires different type of oils and greases.

The heart of any automotive vehicle is the engines which power the vehicle motion. The engines fitted in these vehicles are broadly classified as follows based on the fuel it use and the number of strokes:

Petrol Engines – Spark Ignition Engines

Two Stroke Engines

Four Stroke Engines

Diesel Engines – Compression Ignition Engines

Four stroke petrol engines are used in passenger cars and also in current generation motor cycles, scooters and Auto Rickshaws. Two stroke engines are used in the two wheeler, motor cycles and auto rickshaws.

Diesel engines are used in all commercial vehicles. Also high performance diesel engines are used in certain passenger vehicles also.

The engine technology development is currently driven by the emission standards & fuel economy. Newer version of engines are being introduced time to time for use in the vehicles to comply with the emission standards. As the engine technology improves, the demand of the engines on the lubricant quality also becoming more and more stringent. Hence new high performance oils are continuously being introduced by Bharat petroleum to keep in pace with the challenging demand of the new engine technology.

In this section, the various application of lubricants in an automobile and the Lubricants brands marketed by Bharat Petroleum suiting each of these application are categorised as follows for easy reference:

TWO / THREE WHEELER LUBRICANTS

PASSENGER CARS - PETROL DRIVEN - LUBRICANTS

PASSENGER / COMMERCIAL VEHICLES - DIESEL DRIVEN - LUBRICANTS

DGSET/OFF HIGHWAY / EARTH MOVING EQUIPMENT
LUBRICANTS AGRICULTURAL EQUIPMENTS LUBRICANTS
AUTOMOTIVE OILS AND GREASES – OTHER APPLICATIONS

Industrial Lubricant:

Bearing Lubrication	Compressors and Exhausters
Gear Lubrication	Heat Treatment Of Metals
Heat Transfer Fluids	Hydraulic Equipments
Machining Of Metals	Railroad Oils
Refrigerators	Rust Prevention
Textile Machinery	Turbines
Special Applications	DG Sets
Earth Moving Equipments	Greases

INDUSTRIAL AND COMMERCIAL :

To cater to Industries needs of fuels and other Petrochemicals (used as raw materials for Industries). Bharat Petroleum's Industrial and Commercial Business Unit, commonly known as I&C SBU was formed. Currently Bharat Petroleum caters to approx. 8000 Industrial customers spread across all over the country. These include Industries from the Public & Private Sectors, of the core and non-core segments and various Govt. Establishments, such as Defence, Railways, State Trading Corporations, and State Electricity Boards etc.

All major Industrial Customers, so as to say, the who's/who of the Industrial world such as, Reliance Industries (RIL), ITC, TATA, Birla group of companies, Telco, BALCO, Sriram Fertilizers feature in our

list of esteemed customers. Major products handled include fuels (HSD, LSHS, NAPHTA, FO) Solvents (MTO, SBP, Hexane) and specialty products such as benzene, toluene, bitumen, etc.

Majority of industrial products are sold to customers from Bharat Petroleum's 3 refineries set in Bombay, Cochin & Numaligarh. However, customers desirous of uplifting products from near to their Industries can also avail the services from Bharat Petroleum's supply locations - strategically spread across the country. Though normally product is sold ex - supply locations, on a specific request from its customers, Bharat Petroleum also delivers the product at their doorstep. To some of its large customers situated in the vicinity of a Refinery, product is delivered through pipelines. Customers such as TATA's @ Trombay, RIL @ Patalganga, FACT @ Cochin receive product through pipelines. BPCL also has ambitious plans to market 0.5 MMTPA of LNG ex-Dahej by 2003 & 2005 ex-Cochin. The commerce e-initiative

BPCL has leveraged Information Technology as an enabler to establish a leadership position in the Oil Industry. Initially integrating all its business operations with an ERP from SAP was the first step, and then subsequently capping with an B2B site.

Enhanced customer satisfaction being BPCL's motto, it became the first oil company to embark on a voyage from Brick to Click (Business-to-Business e-commerce). This B2B portal enables the customer to place an order online, track the status of his order, view dispatch information, which results in better inventory management, better financial information and more convenience for them.

The portal is also integrated with the ERP system, which now reduces the response time, and helps to capture data from Kochi and Numaligarh refineries. The portal also enables customers to view their statement of accounts, thus enabling sharing of the complete information with the customers.. There are also plans on the anvil to introduce an option for customers to be able to integrate the portal with their own system, which will greatly cut down the order fulfillment time.

Bharat Petroleum's B2B initiative continues to generate a very positive response from the customers. As on the date of this report, nearly 3800 customers use this portal and approximately Rs. 143 million worth of business is being posted every day through the net. The positive customer feedback has encouraged Bharat Petroleum to draw up a highly ambitious plan to implement this initiative across the country - covering all its 8000-plus customers drawing supplies from its supply locations.

E- Banking

To facilitate easy and convenient way of making payment, Bharat Petroleum has tied up with Banks through which Industrial customers can make payment for their supplies on the Net. This will result in cost saving to the customers and increase efficiency. During March 2002 approx. Rs.1 crore was transacted through e-Banking. It is planned to bring about 20% of the customer in the ambit of e-Banking in the financial year 2002-03 and take up the transaction to Rs. 10 crores per month.

AVIATION :

BPCL is the **pioneers in Aviation fuelling in India**. The history of Bharat Petroleum with Aircraft fuelling began in the days when aviators, those daring young men in their flying machines, took off in their "wood - canvas tied with a prayer" craft into the azure of the Indian skies ... To greet them when they landed was the "red and yellow Shell with wings" emblem of their Aviation Service then, as they were known as Burmah - Shell Aviation Service, till they were nationalised in 1976. Therefore, history of Aviation in India is inseparable from the pioneering spirit of Bharat Petroleum in Aviation. We had laid down the Hydrant System at Santacruz and Palam Airport (both defunct now), in the early 50's.

Since then it has come a long way. It had to shrink at the time of nationalisation and then we expanded. Today, we own & operate Hydrant fuelling Complex at Indira Gandhi International Airport at Delhi & Cochin International Airport at Nedumbassery, Cochin, and are present at all International Airports & International Gateways & strategic domestic airports in India.

With the focussed customer service, today we have 22.0% of the total market share of Jet A-1 in India - foreign airlines contributing 59.64% of our own volume. However, the market share of total volume uplifted by foreign airlines in India is 37.88%, which clearly indicates the faith reposed in us by our valued customers. They are the "Fuellers of the Leading Airlines of the World". The portfolio of their customers include leading airlines of the world and some of these customers are associated with us for more than 6 decades. They have highly skilled, qualified, trained and dedicated staff, to

take care of stringent Quality Control, prompt, efficient and safe operation expected from our demanding customers. They supply aviation fuel, from our strategically located network of 19 Aviation Fueling Stations, spread across the country.

Jet Fuel Marketing

Bharat Petroleum's system of quality auditing and control ensures that we fuel right quality every where.

We produce Jet Fuel to very stringent manufacturing specifications. At every stage between refinery and aircraft tank, we carry out laboratory analysis to check fuel quality. This ensures that the fuel conforms to the requirements, specified for the grade when it is delivered to the aircraft.

We supply Jet A-1 conforming to the latest version of the Aviation Fuel Quality Requirements of IS NO. 1571: 2001

(DEF STAN 91 / 91 ISSUE 4)

We have adopted more stringent quality control & operational practices, and have set standards much above the minimum - laid down by the Directorate General of Civil Aviation, so that at no stage, our Quality Assurance & Practices could be found wanting.

3.2 Hindustan Petroleum Corporation Ltd

REFINERIES :

Without refining, the rich resources of crude petroleum of nature would remain latent. Value-added products from crude petroleum like petrol, diesel, kerosene, liquefied petroleum gas, naphtha and many more products would not be available for growth and development of a nation.

The two coastal refineries at Mumbai and Vishakhapatnam and one joint venture refining facility at Mangalore Refinery & Petrochemicals Limited have been sustaining almost 20% of India's refining requirements. HPCL refineries upgrade the crude petroleum into many value-added products and over 300 grades of lubricants, specialties and greases. The Lubricating Oils Refinery set up at Mumbai is largest refinery in India.

The refinery produces superior quality lube base oils. The offsite product handling facilities of refineries at Mumbai and Vishakhapatnam has been automated. Projects have been implemented and facilities upgraded to produce green fuels like unleaded petrol and low sulphur diesel.

The refineries have been benchmarked by an international agency for various performance parameters. Numerous awards have been bestowed on both the refineries in recognition of the efforts in the field of energy conservation, environment and safety.

LPG :

Since its introduction in 1955, LPG consumption has increased manifold. It has become the household fuel of choice. At last count, HPCL had nearly 22 million domestic LPG consumers.

HP Gas, the HPCL brand of LPG, is bottled at 40 plants spread across the country with a total capacity of 2000 TMT Per Annum.

Safety is ensured at every stage, from bottling to distribution, by subjecting all related operations to the closest scrutiny and conforming to international safety standards, making HP Gas the safe, convenient fuel our consumers have come to trust.

Exiting developments have taken place in the LPG section. In its endeavour to improve the costumer satisfaction, HPCL has launched the 'Ji'Haan', services in 2002, aimed at reinforcing a strong positive service orientation of HP Gas. .

Basis research finding on customers apprehension on the weight of gas in cylinders, HP Gas has, since last year, provided weighing scales to all its delivery boys across the country, given the customer an option to weigh the cylinders at their doorsteps

The Reticulated system or Piped LPG for domestic use is a value addition to customers, with a view to enhance safety, loyalty and uninterrupted supply of gas to households. In this direction, HPCL has successfully installed reticulated supply in Mumbai, Pune, Jaipur, Cochin, Delhi, Visakh, Hyderabad, Kolkata and Bangalore covering more than 1600 flats.

Rural India is an emerging potential market and no business venture can afford to ignore it. However, the specific barriers to the penetration of LPG in rural India are cost - both one-time and recurring – non-availability of LPG owing to a poor distribution system, easy availability of alternative, cheap fuel and low level of product awareness and its benefits. HP GAS has charted out a detailed strategy to address all these barriers and entered rural markets with the launch of 5 Kg cylinders..

As part of its social commitment as a responsible corporate, HPCL has introduced an innovative scheme, HP GAS Rasoi Ghar or the concept of community kitchen, for the upliftment of the poorest of the poor by providing a common cooking platform for a village, where users have to pay only on the basis of the time utilized for cooking. This eliminates both the barriers of one-time high deposit as well as the recurring cost of refills. The company is already operating nearly 1024 such Rasoi Ghars across the country, benefiting more than 15,000 families. Moreover, stalls have been set up in major rural melas such as Pushkar Mela, Sonpur Mela and the like to increase awareness of the benefits of LPG.

INTERNATIONAL OPERATIONS :

At the initial stages, the International Division started out with handling import facilitation for large consumer of Fuel Oils. The divisions also engaged in direct export of lubricating oils to countries like Nepal, Bangladesh, Malaysia, Sri Lanka and Saudi Arabia. In order to expand its operations and tap export market, the Division

has started appointing distributors for marketing to lubricating oils & specialty products.

Presently, distributors in Nepal, Bangladesh & Sri Lanka are regularly marketing HP Products in these countries and we are actively looking at appointing distributors in Africa & Malaysia.

With the rapid changes that are taking place in the Indian Petroleum scenario, the International Division is fast gaining a reputation in the markets. Apart from handling exports of surplus refinery products for HPCL, the International Division has started facilitation of Naphtha exports for the Oil & Natural Gas Commission (ONGC) and is actively seeking new opportunities.

HPCL has exported bulk petroleum products such as Naphtha, Fuel Oils and Gasoline mostly to countries in Far East.

BULK FUEL AND SPECIALITIES :

HPCL's petroleum products cover numerous applications. From automobile, aviation marine and power plant fuels to being used in the manufacture of products such as fertilizers, carbon black, jute, insecticides, cosmetics, edible oil, fabrics compact discs and medicines.

We are the second largest producers of Bitumen in India with annual sales of more than 600 Thousand Metric Tonnes (TMT). Ongoing R&D to meet the fast changing and critical needs of costumers have resulted in several product improvements like rubber & polymer modified bitumen and emulsions.

For over 25 years, HPCL has been providing fuelling services at all the major Indian ports. We are the marine lube partners of Total Lubrifiants, France , manufacturing and supplying the TOTAL brand of marine lubes.

HPCL is one of the largest suppliers of fuel to state owned and Independent Power Plants (IPPs).We also cater to the Industries requirement of Specialities like Hexane, Solvents, MTO etc

LUBRICANTS :

The HP Engine Oils product range covers over 300 brands of lubricants, greases and specialities catering to the automotive as well as industrial sector. With consumers recognizing the importance of high quality lubricants in ensuring prolonged and trouble-free operations, the demand for HP engine oils, gear oils, transmission oils, greases and other specialities have gone up appreciably over the years.

Behind the success of HP Engine Oils lies years and years of research and technical expertise. They are engineered to meet the rigours of modern automobiles and the extreme service conditions of highly sophisticated industrial machines.

HPCL has six lube blending plants at Mumbai, Calcutta, Chennai and Silvassa.

Based on extensive market research, the lubes business unit has launched several new brands, which have become highly successful

in the market. A large number of new industrial grades have also been introduced to meet specific requirements of industrial consumers.

HPCL has also introduced a large number of Exclusive Lube Distributors who are accessing remote corners of the Bazaar trade. To cater to small volume customers, HPCL has recently launched CFAs

Our market now extends to countries like Nepal, Sri Lanka, Bangladesh, Saudi Arabia and Malaysia.

RETAIL :

The retail business unit of HPCL is oriented towards delivering better and faster service to consumers. Recognizing that our consumers will be better served by offering them a wide range of non-fuel services, the corporation has sized the opportunity through some extensive market research backed initiatives.

Our new retail brand, 'Club HP' seeks to redefine the way fuel are retailed in India. Offering the promise of outstanding care for the customer and the vehicle, Club HP will create a large base of loyal consumers who will look for the distinct red and blue logo whenever they need fuel for their vehicle. Club HP outlets offer one stop convenience so that one can do many things in same window of time - pay his bills, shop for groceries, visit the ATM, get a quick check done on their vehicle and even arrange servicing and repairs if need arises.

Club HP outlets in major cities offer new generation fuels, blended with specially imported multi-functional additives. Power, our branded petrol has created a niche for itself and is already a favorite of the discerning consumers. Turbojet, the first branded diesel to be launched in country, is proving to be equally the favorite of the personal diesel vehicle owners in urban markets.

The business unit has also introduced a novel pre-paid smart card called 'HP Smart 1' to make shopping at HPCL outlets even more convenient and fun. Employing the advanced technological innovations available today the 'HP Smart 1' makes cashless payment a reality.

The 'HPCL-ICICI Bank Credit Card' has already proven to be the preferred credit card among vehicle owners, with nearly 9,25,000 cards already in the market. Our latest innovation, a Fleet Card, 'Drive Track' has – a fleet management tool has already hit the market place.

A national wide chain of convenience stores, tie-ups with leading fast-food and refreshment companies to set up food counters, a special arrangement with Fed Ex to provide world class courier service, facilitation of vehicle insurance, international money faster counters- it is all happening at the HP retail outlets. All you need to do is just drive in!

AVIATION :

HP Aviation offers into-plane fuel service at the major airports in India. Hindustan Petroleum's Aviation Service Facilities, Intermediate Storage Installations and Laboratories handling Jet Fuel are approved and periodically audited by the Directorate General of Civil Aviation, Government of India (DGCA).

HP Aviations installations at Mumbai, Delhi, Chennai, Kolkata, Cochin and Calicut are certified to the ISO 9001:2000 standards.

Mumbai Refinery

HPCL Mumbai Refinery with an installed capacity of 5.5 Million Tonnes Per Annum (MMTPA) is one of the most complex in the country is constructed on an area of 321 acres. This versatile refinery which is first of INDIA's modern refineries, symbolises the country's industrial strength and progress in the oil industry. This fully integrated refinery comprises of Fuels and Lube Blocks.

Initially, Mumbai Refinery was started in 1954 as a Fuels Refinery block with crude processing capacity of 1.25 MMTPA having following processing units :

Crude Distillation Unit

Catalytic Cracking Unit

Thermal Reformation

Treating Units

At that time, the refinery used to produce just 5 grades of products namely Petrol, Kerosene, Diesel, LDO and Furnace Oil. The

expansion of Mumbai refinery over the years has brought its capacity to 5.5 MMTPA and various processing units like, Bitumen Blowing, Food Grade Hexane, Solvent 14/25, etc. have been added to the refinery.

A low cost expansion of the fuels refinery was undertaken in 1985 whereby a separate crude distillation unit and vacuum distillation unit were installed with crude processing capacity of 2.0 million tonnes. It was the first swing refinery of its kind in the country, which had the flexibility to process heavy Lube bearing high sulphur as well as non Lube bearing low sulphur curds of various types. This particular unit called FRE (FUEL REFINERY EXPANSION) gave the flexibility to process various types of curds.

The Lube Refinery which produces Lube Oil Base Stocks was commissioned in 1969 as a joint venture between Esso and Government of India with a capacity of 1,65,000 T of LOBS. This Lube refinery processes Reduce Crude Oil, from Persian Gulf crude, in the vacuum tower to get various grades of Lube Oil Base stocks. In the year 1975 Lube India Ltd was fully taken over by Government of India and it was merged with HPCL. As the demand for Lube oil base stocks and middle distillate went up further, in 1977, a second Vacuum Distillation unit was started. In the year 1983 Lube refinery processing units were further debottlenecked and capacity increased to 2,25,000 T to meet growing demand of Lube products.

Lube Oil Base Stocks production got a fillip with the commissioning of Lube Refinery Expansion stage two in 1994 - 95 when new Propane Deasphalting Unit, Extraction Unit and a Hydrogen Plant

were added. The old Extraction Units were modified so that an ECOFRIENDLY solvent NMP could be used instead of toxic Phenol, which was being used previously. After this expansion the capacity of Lube Refinery has gone up to 3,35,000 TPA of LOBS which is the largest of its kind in India and represents about 41 % of installed capacity in the country. An important milestone in the growth of Mumbai Refinery was the commissioning of Gas Turbine based Captive Power Plant in 1989 thus making the Mumbai Refinery independent of the vagaries of supply of power. Initially 3 units of GTGs were commissioned with total installed capacity of 30 MW ISO rating. These units were designed to run on BH gas/ refinery naphtha, which would cause minimum air pollution. Presently, Mumbai Refinery has 5 units of GTGs with a total installed capacity of 65 MW ISO rating making Mumbai Refinery self sufficient on power requirement.

Another milestone in increasing the productivity of the refinery was the replacement of pneumatic control system with latest microprocessor based Digital Control System in 1995 - 96.

Mumbai refinery has successfully commissioned Diesel De-Hydro De-sulphurization (DHDS) and Sulphur Recovery Unit (SRU) in 2000 to reduce sulphur content in diesel up to 0.25 wt %.

Yet another step in the field of automation was commissioning of Computerised Maintenance Management System (CMMS) called MAXIMO in January 2001. MAXIMO is considered to be the best - of - breed of all the modern systems that provide Maintenance and Materials management support. HPCL is one of the few

organisations in the world who have implemented all the features of the above package. This has improved our competitiveness with regard to increased plant uptime and reduced inventory of maintenance spares.

The Refinery has over the years, built flexibility to process various types of crudes. It has processed 43 different types of High Sulphur & Low Sulphur crudes. Major crudes processed are :

High Sulphur Crudes :

Arab Mix

Basrah

Upper Zakum

Iranian Light

Low Sulphur Crudes :

Bombay High

Qua Iboe

Labuan, Tapis, Marib, Bonny Light .

TABLE 3.1 PRODUCTS (HIST.) MUMBAI REFINERY¹

	99-00	00-01	01-02	02-03	2003-04
LPG	136	129	152	144	154
LPG/C3-Own use	11	12	12	11	8.0
MS 87/93	259	221	263	244	259
Hexane	45	38	37	36	43
Sol. 1425	13	15	12	11	11
LAN	559	453	503	535	540
HAN	57	150	83	125	156
MTO	50	50	44	45	51
ATF	357	379	412	435	476
SKO	297	438	453	492	392
HSD	1659	1318	1393	1427	1519
LDO	316	281	269	283	288
SPO	12	9	15	26	20
150 N	71	55	48	57	57
500 N	170	158	172	170	183
1300 N	4	2	4	0	0
150 T/500 T	0	5	0	0	0
BS	23	37	31	44	16
Railex	0	0	0	0	0
RPO	18	18	17	18	14
LSHS	171	137	125	203	175
CBFS	39	39	32	20	29
IFO	1150	946	905	1047	976
ASPH	304	298	246	273	338
Sulphur	0	7	10	10	11
T'put	6002	5575	5631	6079	6108

¹ www.hindustanpetroleum.com

Visakh Refinery

HPCL Visakh Refinery was commissioned in 1957 as Caltex Oil Refining India Limited [CORIL]. It was the First Oil refinery on the East Coast and the first major industry in the city of Visakhapatnam, Andhra Pradesh. The Installed capacity of the refinery was 0.65 Million Metric Tonnes per Annum [MMTPA] in 1957. CORIL was taken over by Government of India and merged with Hindustan Petroleum Corporation Limited [HPCL] in 1978.

The Refinery has expanded in phased manner over the years. The First expansion of Refinery after 1957, was through debottlenecking of units in 1978 wherein the crude processing capacity increased from 0.65 MMTPA [13200 bbls/day] to 1.5 MMTPA [30400 bbls/day] 1978.

Another Major expansion of the refinery was completed in 1985 in which the crude processing capacity increased from 1.5 MMTPA [30400 bbls/days] to 4.5 MMTPA [91200 bbls/day].

In order to meet the growing demand of petroleum products in the country, an another major expansion project was carried out and completed in 1999. After the commissioning of this expansion project, the crude processing capacity increased from 4.5 MMTPA [91200 bbls/day] to 7.5 MMTPA [152000 bbls/day].

Visakh refinery has successfully commissioned Diesel De-Hydro De-sulphurization (DHDS) and Sulphur Recovery Unit (SRU) in 2000 to reduce sulphur content in diesel up to 0.25 wt %.

Visakh Refinery is Fuels Based Refinery generating major products of mass consumption like Petrol, Diesel and Kerosene. Hence, crude meeting General Purpose Characteristics can be processed with the existing refinery configuration. Visakh Refinery has a flexibility to process wide range of crudes procured across the globe and ranging from very high sulphur to low sulphur and non bituminous category to Bituminous and Lubes based crudes.

TABLE 3.2 HISTORICAL DATA ON PRODUCTIONS VISAKH REFINERY²

	99-00	00-01	01-02	02-03	2003-04
PROPYLENE	19	25	22	30	32
LPG	116	229	293	279	324
LAN	429	682	602	603	846
MS	398	637	715	676	735
MS 93 R	0	0	0	0	0
MTO	3	6	8	1	2
ATF	0	22	33	52	95
KO	314	603	676	637	732
HSD	2241	2590	2784	2743	2796
JBO	9	8	8	7	8
LDO	19	29	51	114	111
FO	249	482	625	623	849
LSHS	425	600	404	388	385
SULFUR	0	3	7	11	11
BIT	31	70	107	221	289
TPUT	4555	6405	6706	6851	7591

1. THE REFINERIES

Indian Oil controls 10 of India's 18 refineries with a current combined rated capacity of 54.20 million metric tonnes per annum (MMTPA)* (one million barrels per day). Indian Oil refineries registered a record throughput of 36.63 million tonnes during the year 2004-05 with a capacity utility of 88.6%.. Overall Energy consumption of Indian Oil refineries was lowest at 109 MBTU/ BBL/ NRGF against earlier best of 111, achieved in 2003-04.

Gross Refining Margin (GRM) rose by almost one dollar per barrel during the year 2004-05. It is expected to be the highest at US\$ 6.25/bbl for the year 2004-05 as against \$5.30/bbl in 2003-04

All refinery units are accredited with ISO 9002 and ISO 14001 certifications.

* (MMTPA- Million metric tonnes per annum, equal to 20,000 barrels per day)

* Million British Thermal Unit/ Per Barrel Energy Factor

TABLE 3.3 Indian Oil Refineries: Installed Capacities³

Refinery	As on 1.4.00	As on 1.4.01	As on 1.4.02	As on 1.4.03	As on 1.4.04	As on 1.4.05
IOC						
IOC- Guwahati	1.0	1.0	1.0	1.0	1.0	1.0
IOC- Barauni	3.3	4.2	4.2	6.0	6.0	6.0
IOC- Koyali	13.0	13.7	13.7	13.7	13.7	13.7
IOC- Haldia	4.6	4.6	4.6	4.6	6.0	6.0
IOC- Mathura	7.5	8.0	8.0	8.0	8.0	8.00
IOC- Digboi	0.65	0.65	0.65	0.65	0.65	0.65
IOC- Panipat	6.0	6.0	6.0	6.0	6.0	6.0
Sub-Total IOC	36.05	38.15	38.15	39.95	41.35	41.35
IOC Subsidiaries						
CPCL- Chennai	6.5	6.5	6.5	6.5	9.5	9.5
CPCL- Narimanam	0.50	0.50	0.50	1.0	1.0	1.0
BRPL- Bongaigaon	2.35	2.35	2.35	2.35	2.35	2.35
Sub-Total IOC Subsidiaries	9.35	9.35	9.35	9.85	12.85	12.85
IOC-Total(With- Subsidiaries)	45.40	47.50	47.50	49.80	54.20	54.20

³ www.iocl.com

Digboi Refinery (Upper Assam)

The Digboi Refinery in North Eastern India is India's oldest refinery and was commissioned in 1901. Originally a part of Assam Oil Company, it became part of Indian Oil in 1981. Its original refining capacity had been 0.5 MMTPA since 1901. Modernisation project of this refinery has been completed and the refinery now has an increased capacity of 0.65 MMTPA. The Digboi refinery produces distillates, heavy ends and excellent quality wax from indigenous crude oil produced at the Assam oil fields. Petroleum products are supplied mainly to north-eastern India primarily through road and by rail wagons. A new Delayed Coking Unit of 1,70,000 TPA capacity was commissioned in 1999. A new Solvent Dewaxing Unit for maximizing production of micro-crystalline wax was installed and commissioned in 2003. The refinery has also installed Hydrotreater to improve the quality of diesel.

Guwahati Refinery (Assam)

The Guwahati Refinery in North East India -- the first Public Sector refinery of the country -- was commissioned in 1962 with a capacity of 0.75 MMTPA which was subsequently increased to 1.0 MMTPA through debottlenecking projects. The refinery processes only indigenous crude oil from the Assam oil fields. With its main secondary unit, a coking unit, it produces middle distillates from heavy ends and supplies petroleum products to North-Eastern India, and surplus products onward to Siliguri in West Bengal in 2003. Hydrotreater Unit for improving the quality of diesel has been commissioned in 2002. In 2003, the refinery installed an Indmax Unit, a novel technology developed by

IndianOil's R&D Centre for upgrading heavy ends into LPG, Motor Spirit and Diesel oil. **Barauni Refinery (Near Patna, Bihar)**

The Barauni Refinery in Eastern India was commissioned in 1964 with a capacity of 2.0 MMTPA. The refining capacity was increased to 3.0 MMTPA by 1969 and further to its current capacity of 6.0 MMTPA through low cost revamping and debottlenecking. Matching secondary processing facility such as RFCC (Resid Fluidised Catalytic Cracker) and hydrotreater facilities for diesel quality improvement have been added. Earlier, refinery's crude input was primarily from the Assam oil fields through pipeline. With the commissioning of the 6.0 MMTPA Haldia-Barauni crude oil pipeline, the refinery now receives imported crude for processing. A CRU (Catalytic Reformer Unit) was also added to the refinery in 1997 for production of unleaded motor spirit. Projects are also planned for meeting future fuel quality requirements. Barauni Refinery supplies distillate products besides eastern India to northern India through a product pipeline to Kanpur in Uttar Pradesh.

Gujarat Refinery (Near Ahmedabad)

The Gujarat Refinery at Koyali in Gujarat in Western India is IndianOil's largest refinery. The refinery was commissioned in 1965. Its facilities include five atmospheric crude distillation units. The major units include CRU, FCCU and the first Hydrocracking unit of the country. Through a product pipeline to Ahmedabad and a recently commissioned product pipeline connecting to BKPL product pipeline and also by rail wagons/trucks, the

refinery primarily serves the demand for petroleum products in western and northern India.

When commissioned, the Gujarat refinery had a design capacity of 3.0 MMTPA. It was subsequently increased to 4.3 MMTPA by the revamping of three distillation units. In 1978, its processing capacity was further increased to 7.30 MMTPA by the addition of a crude distillation unit. A fluidised catalytic cracking unit was added to the refinery in 1981 to increase production of middle distillates, such as diesel and LPG. The capacity of the refinery was further increased to 9.5 MMTPA by 1990 through low cost revamping / debottlenecking and addition of a hydrocracker in 1992 for maximisation of middle distillates. Subsequently the crude capacity was increased to 12.5 MMTPA in 1999 by addition of new Atmospheric Unit of 3 MMTPA alongwith revamp of FCC Unit. The capacity has since been increased to its present capacity of 13.70 MMTPA by low cost debottlenecking. The company has already commissioned the facilities for MTBE and Butene-1 production. The refinery also produces a wide range of specialty products like Benzene, Toluene, MTO, Food Grade Hexane, solvents, LABFS, etc. The Gujarat Refinery achieved the distinction of becoming the first refinery in the country to have completed the DHDS (Diesel Hydro De-sulphurisation) project in June 1999, when the refinery started production of HSD with low sulphur content of 0.25% wt (max.).

A project for production of high value LAB (Linear Alkyl Benzene which is one of the major raw materials used in manufacturing detergents) from kerosene streams has been implemented. In

order to meet future fuel quality requirements, MS Quality improvement facilities are planned to be installed by 2006.

Gujarat Refinery: 1961 Onwards

- Following the conclusion of an Indo-Soviet agreement in 1961 February, a site for the establishment of a 2 million tonne oil refinery in Gujarat at Koyali near Vadodara was selected on the 17th April 1961.
- The Soviet and Indian engineers signed a contract in October 1961 for the preparation of the project report jointly.
- On 10th May 1963, the then Prime Minister of India, Pandit Jawaharlal Nehru laid the foundation stone of the refinery.
- The first million tonne Crude Distillation Unit was commissioned for trial production on 11th October 1965 and full production at the rated capacity was achieved on 6th December 1965. The throughput was further increased by 20% beyond the designed capacity in January 1966.
- Dr S Radhakrishnan, the then President of India, dedicated the refinery to the nation with the commissioning of second crude distillation unit and Catalytic Reforming Unit on 18th October, 1966.
- The third 1.0 mmtpa crude distillation unit (AU-3) was commissioned in September 1967 to process Ankleshwar & North Gujarat crudes thus raising the refining capacity to 3.0 mmtpa.
- In December 1968, Udex plant was commissioned for production of benzene & toluene using feedstock available from CRU.

By 1974-75 with in-house modifications, the capacity of the refinery was further increased by 40% to a level of 4.2 mmtpa.

➤ To process imported crude the refinery was expanded during 1978-79 by adding another 3 mmtpa crude distillation unit (AU-4) along with downstream processing units like Vacuum Distillation, Visbreaker & Bitumen Blowing Unit. By 1980-81 this unit started processing Bombay High crude in addition to imported crudes. It was for the first time in Indian petroleum industry that Indian engineers independently handled such a big project.

➤ To recover high value products from the residue, the secondary processing facilities consisting of Fluidized Catalytic Cracking Unit (FCCU) of 1.0 mmtpa capacity along with a Feed Preparation Unit (FCCU) of 1.0 mmtpa capacities, were commissioned in December 1982. Refinery also set up Pilot Distillation Facilities (PDF) for the production of N- Heptane & light Aluminum Rolling Oils (LARO). Meanwhile, to enable absorption of increased indigenous crudes the crude processing capacity of the refinery was further increased to 9.5 mmtpa.

➤ In 1993-94, Gujarat commissioned the country's first Hydrocracker Unit of 1.2 mmtpa for conversion of heavier ends of crude oil to high value superior products.

➤ Country's first Diesel Hydrodesulphurisation Unit (DHDS) to reduce sulphur content in diesel was commissioned by Gujarat Refinery in June 1999. Also commissioned in September eliminate lead in MS. Also MTBE Unit was commissioned in September 1999 to eliminate lead in MS.

- Conceptualized and commissioned South-East Asia's largest centralized effluent treatment plant by dismantling all the four old ETP's in June 1999.
- By September 1999 with commissioning of atmospheric distillation unit-5, Gujarat Refinery further augmented its capacity to 13.7 mmtpa making it the largest PSU refinery of the country.

Haldia Refinery (Near Kolkata, West Bengal)

Haldia Refinery, the fourth in the chain of seven operating refineries of IndianOil, was commissioned in January 1975. It is situated 136 km downstream of Kolkata in the district of East Midnapur, West Bengal, near the confluence of river Hoogly and river Haldi. The refinery had an original crude oil processing capacity of 2.5 MMTPA. Petroleum products from this Refinery are supplied mainly to eastern India through two Product Pipelines as well as through Barges, Tank Wagons and Tank Trucks. Products like MS, HSD and Bitumen are exported from this refinery.

The strategic significance of this Refinery lies in its being the only coastal refinery of the Corporation and the lone lube flagship, apart from being the sole producer of Jute Batching Oil and Russian Turbine Fuel. Capacity of the Refinery was increased to 2.75 MMTPA through de-bottlenecking in 1989-90. Refining capacity was further increased to 3.75 MMTPA in 1997 with the installation/commissioning of second Crude Distillation Unit of 1.0 MMTPA capacity. Diesel Hydro Desulphurisation (DHDS) Unit

was commissioned in 1999, for production of low Sulphur content (0.25% wt) High Speed Diesel (HSD). With augmentation of this unit, refinery is producing BS-II and Euro-III equivalent HSD (part quantity) at present.

Resid Fluidised Catalytic Cracking Unit (RFCCU) was commissioned in 2001 in order to increase the distillate yield of the refinery as well as to meet the growing demand of LPG, MS and HSD. Refinery also produces eco friendly Bitumen emulsion and Microcrystalline Wax. In addition, a Catalytic Dewaxing Unit (CIDWU) was installed and commissioned in 2003, for production of high quality Lube Oil Base Stocks (LOBS), meeting the API Gr-II standard of LOBS. This is the only refinery in the country to produce such high quality LOBS.

In order to meet the Euro-III fuel quality standards, the MS Quality Improvement Project has been incorporated for production of Euro-III equivalent MS. Currently the unit is under stabilisation. At present, the Refinery is operating at a capacity of 5.5 MMTPA. Refinery expansion to 7.5 MMTPA as well as a Hydrocracker project has been approved for Haldia Refinery, commissioning of which shall enable this Refinery to supply entire Euro – III HSD to the eastern region of India.

Mathura Refinery (Near Delhi)

The Mathura refinery was commissioned in 1982 with an original capacity of 6.0 MMTPA. The capacity was increased to 7.5 MMTPA by debottlenecking and revamping. With its fluid catalytic cracking units, the refinery mainly produces middle distillates and

supplies them to Northern India through a product pipeline to Jalandhar, Punjab via Delhi. The company commissioned a two-stage desalter in 1998 for improving the on-stream availability of the crude distillation unit and a CCRU for production of unleaded Motor Spirit. A DHDS Unit was commissioned in 1999 for production of HSD with low Sulphur content of 0.25% wt (max). A hydro-cracker for increasing middle distillates was also completed in 2000. The present capacity of the refinery is 8 MMTPA.

In order to meet future fuel requirements, facilities for improvement in quality of MS & HSD are under installation and planned to be completed by 2005.

Panipat Refinery (Near Delhi)

Indian Oil's seventh refinery, commissioned in 1998, is located at Panipat, 125 kms away from Delhi, the capital of India, in the state of Haryana in Northern India. The main units are OHCU (Once-through-hydrocracker), RFCC, CCRU (Continuous Catalytic Reformer unit) besides other secondary treatment units. This 6 MMTPA refinery caters to the high demand centres of North India.

A DHDS unit for production of low sulphur HSD was added in July 1999 - the second such unit to be commissioned in the country for production of HSD with low Sulphur content of 0.25% wt (max). The project to increase the capacity of Panipat Refinery to 12 MMTPA is already under implementation, which also takes into account future fuel quality requirements for 2005. The expansion project is expected to be completed in 2005.

2. PIPELINES

Long distance pipelines are the most viable, economic, safest and environment friendly mode to transport crude oil and petroleum products.

Indian Oil, as an environment conscious corporate entity, has pioneered in transportation of petroleum products from its refineries to the various major demand centres of this geographically vast country, and feeding the landlocked refineries through underground crude oil pipelines.

Indian Oil operates a total network of 8952 km crude oil and petroleum product pipelines with a combined capacity of 60.42 million tonnes per annum throughput, consisting of 2813 km long crude oil pipeline network with a capacity of 28.50 million metric tonnes and 6139 km long petroleum product pipelines with a capacity of 31.92 million metric tonnes.

Started with the commissioning of the 435 km long Guwahati-Siliguri Pipeline on October 25, 1964, Indian Oil today is the leader in pipeline engineering, construction, operations, maintenance and training services.

With over four decades experience, the highly qualified pipeline professionals execute pipeline projects from concept to commissioning and provide services for construction supervision, project management, operation and maintenance.

3. CRUDE OIL PIPELINES

Salaya-Mathura Pipeline (SMPL)

Indian Oil operates the 1870 km long Salaya-Mathura Pipeline from Salaya (near Vadinar) in Jamnagar district on the coast of Gujarat to bring crude oil to IndianOil's refineries at Koyali (Gujarat), Mathura (Uttar Pradesh) and Panipat (Haryana). Two Single Point Mooring (SPM) systems are operated at Vadinar to unload the crude oil received from tankers including Very Large Crude oil Carriers (VLCCs) with offshore pipelines. At Vadinar, Indian Oil has a vast crude oil tank farm of 13 tanks with a total capacity of 11.05 million kilolitres. Indian Oil also has crude oil storage tank farm at Viramgam with a total capacity of 5.15 million kilolitres. Another storage tank farm at Chaksu has six tanks with a total capacity of 3.60 million kilolitres.

After traversing 435 km from Vadinar, Salaya-Mathura Pipeline branches at Viramgam in Gujarat through a 148 km pipeline to Koyali (Baroda). Further, after 716 km, the pipeline branches at Chaksu to Mathura and Panipat.

Haldia-Barauni Crude Oil Pipeline (HBCPL)

The 943 km long Haldia-Barauni Crude Oil Pipeline is in the eastern part of the country. It receives crude oil at Haldia oil jetty and transports to IndianOil's Barauni refinery in Bihar. The crude oil tank farm at Haldia has eight large crude oil tanks with a total capacity of 4.80 million kilolitres.

The crude oil requirement of IndianOil's subsidiary BRPL's refinery at Bongaigaon is also partly transported through HBCPL up to Barauni.

TABLE : 3.4 Total Length and Capacity of Petroleum Product and Crude Oil Pipelines⁴

S. No	Name of the Pipeline	Year of commissioning	Length (km)	Capacity (MMTPA)
A. PRODUCT PIPELINES				
1.	Guwahati-Siliguri	1964	435	0.818
2.	Koyali - Ahmedabad	1966	116	1.10
3.	Barauni – Kanpur	1966	745	3.50
4.	Haldia- Barauni	1967	525	1.25
5	Haldia-Mourigram – Rajbandh	1972	277	1.35
6.	Mathura - Jalandhar	1982	763	3.70
7.	Kandla- Bhatinda	1996	1443	8.80
8.	Koyali- Navagam	2003	78	1.80
9.	Koyali- Viramgam - Sidhpur – Sanganer	2003/2005	788	4.10
10.	Mathura – Tundla	2003	56	1.20
11.	Panipat Rewari Pipeline	2004	155	1.50
12.	Chennai Trichy Madurai Pipeline	2005	683	1.80
13.	Digboi- Tinsukia	1956	75	1.00
			6139	31.918
B. CRUDE OIL PIPELINES				
1.	Salaya – Mathura	1978	1870	21.00
2.	Haldia – Barauni	1999	943	7.50
			2813	28.50
Total Length and Capacity of Petroleum Product and Crude Oil Pipelines			8952	60.418

⁴ www.iocl.com

4. PETROLEUM PRODUCT PIPELINES

Guwahati-Siliguri Pipeline (GSPL)

Guwahati-Siliguri Pipeline was commissioned in 1964. Designed by Bachtel, USA and constructed by Snam Progetti, Italy, it has the unique distinction of being the first product pipeline to be built in the east of Suez. The 435 km long pipeline originates at Guwahati refinery, transporting petroleum products for delivery at Betkuchi, Hashimara and Siliguri. GSPL represents the cradle of IndianOil's capabilities in operations and maintenance of pipelines.

Koyali - Ahmedabad Pipeline (KAPL)

The 116 km long Koyali - Ahmedabad Pipeline was commissioned in April 1966. Designed and constructed by Snam Saipen, Italy, the pipeline carries a variety of petroleum products from IndianOil's Koyali refinery to the Sabarmati terminal (Ahmedabad) through a high population density route within the state of Gujarat.

Haldia - Barauni Pipeline (HBPL)

Commissioned in 1967, the Haldia - Barauni Pipeline originates at Haldia and terminates at Barauni. This pipeline exemplifies IndianOil's expertise in system modification and pipeline hydraulic engineering. The pipeline was commissioned as a petroleum product pipeline but for some initial years, the pipeline was used to transport imported crude oil to Barauni. After some years, the pipeline started pumping petroleum products from Barauni

refinery to Haldia. After Haldia refinery came into being, pumping was again reversed and at present, the pipeline is engaged in transportation of indigenous as well as imported petroleum products from Haldia.

Barauni - Kanpur Pipeline (BKPL)

The 745 km long Barauni - Kanpur Pipeline was commissioned on September 26, 1966. It transports petroleum products from Barauni refinery. The pipeline has boosting-cum-delivery stations at Patna, Mughalsarai, Allahabad and terminates at Kanpur. A branch pipeline was taken out from Gowria to Amousi (Lucknow).

Haldia-Mourigram-Rajbandh Pipeline (HMRPL):

The 277 km long Haldia-Mourigram-Rajbandh Pipeline was built in early 1972 for transportation of petroleum products from IndianOil's Haldia refinery to Kolkata and beyond. It has delivery stations at Mourigram and Rajbandh. An eight km long branch pipeline was taken out at Raghudevpur to Budge Budge in 1999 crossing the river Hoogly.

Mathura-Jalandhar Pipeline (MJPL):

Mathura - Jalandhar Pipeline was commissioned in 1984. It was designed by Indian Oil with in-house construction supervision. The 763 km long pipeline transports petroleum products from Mathura refinery to Jalandhar in Punjab with delivery at Bijwasan in Delhi and Ambala in Haryana. During 1997, the pipeline was connected to Panipat refinery, enabling transport of petroleum

products from Panipat refinery as well as the products pumped through IndianOil's Kandla-Bhatinda Pipeline. The pipeline has a branch line from Sonapat to Meerut and from Kurukshetra to Najibabad via Roorkee.

Mathura-Tundla Pipeline (MTPL):

A 55 km long separate pipeline was also laid from Mathura to Tundla to transport petroleum products from Mathura refinery.

Kandla - Bhatinda Pipeline (KBPL):

Commissioned in 1996, the 1443 km long Kandla-Bhatinda Pipeline, with a capacity of 8.8 MMTPA, pumps petroleum products from Gujarat coast to the heartland of Punjab. As Indian Oil is doubling the refining capacity of Panipat Refinery from 6 MMTPA to 12 MMTPA, this pipeline is also being converted to transport crude oil from Mundra port to Panipat refinery.

Panipat-Rewari Pipeline (PRPL):

The 155 km long 12 inch diameter Panipat-Rewari petroleum product pipeline was commissioned in September, 2004 for transporting petroleum products from Panipat refinery to the agricultural and industrial demand areas of Haryana.

Koyali-Viramgam-Sidhpur-Sanganer Pipeline (KVSSPL):

The 249 km long Koyali – Viramgam – Sidhpur petroleum product pipeline was extended with a 518 km long pipeline upto Sanganer connecting with the Kot – Salawas branch pipeline at Kot and delivery facilities at Sanganer terminal. A 21 km long branch

Pipeline has also been commissioned from Sidhpur – Sanganer Pipeline to Ajmer in August 2005. The total length of the pipeline including the branch line is now 788 km.

Chennai – Trichy - Madurai Product Pipeline (CTMPL):

Chennai – Trichy - Madurai Product Pipeline consists of 526 km long pipeline from Chennai to Madurai and 157 km branch pipeline to Sankari. The Pipeline was commissioned on August 24, 2005.

5. MANUFACTURED PRODUCTS

All the Public Sector companies produce the below products:

<u>Products</u>	
LPG	LIGHT DIESEL OIL / MLO
NAPHTHA/NGL	LUBES / GREASES
MOTOR SPIRIT (Gasoline / Petrol)	FURNACE OIL / LSHS
ATF (Jet Fuel) / JPS	BITUMEN
SKO(Superior Kerosene Oil)	FTP Products
HIGH SPEED DIESEL (Gas Oil)	CNG

DETAILS OF MANUFACTURED PRODUCTS:

TABLE 3.5

1. Superior Kerosene Oil (SKO)⁵

Sr. No.	Characteristics	Requirements	Test Method [P:] of IS:1448
1	Acidity (inorganic)	Nil	[P:2]
2.	Burning Quality	20	[P:5]
	a) Char Value mg/kg of oil consumed	(Not darker than grey)	
	b) Bloom on glass chimney		
3.	Colour (Saybolt)	Min 10 (undyed SKO)	[P:14]
4.	Copper strip corrosion for 3 Hrs at 50 deg C	Not worse than 1	[P:15]
5.	Distillation	20	[P:18]
	a) Percentage Recovery elow 200 deg C Min	300	
	b) Final Boiling Point 200 deg C Min		
6.	Flash point (Abel) deg C Min	35	[P:20]
7.	Smoke Point mm Min 22	18 for general	[P:31]
	Defence & Railways signal lamps		
8.	Total Sulphur % wt max 0.2 for defence	0.25 for others	[P:34]

SKO is broadly used as:

- an illuminant in various lamps
- a fuel in cooking stoves/ranges, ovens, blow lamps
- a cleaning fluid /degreasing components
- solvents in paints/printing inks
- Raw material for the manufacture of n paraffins.
- Most importantly as a low sulphur fuel in boilers /furnaces

⁵ www.bharatpetroleum.com

2. Light Diesel Oil (LDO)

Light Diesel Oil falls under class C category fuel having flash point above 66°C. It is a blend of distillate components and a small amount of residual components. It is marketed under BIS 1460-2000 specification for Diesel fuels.

Whereas HSD is used as a fuel for high-speed engines having 750 RPM and above in most of the prime movers used, LDO is used in lower RPM engines. It is used in Lift irrigation pumpsets, DG Sets and as a fuel in certain boilers and furnaces.

Safety Information :

- Reactivity Data - Chemically stable and incompatible with strong oxidizers. Does not React vigorously with common materials but may react with oxidizing agents Health Hazard Data - Routes of entry may be through inhalation/ ingestion/ skin/ eye.

Effects of Exposure / Symptoms :

- Inhalation causes dizziness and headache.
- Ingestion may lead to nausea vomiting, irritation of mouth and gastro-intestinal effects likely. Potentially fatal chemical pneumonitis.

On Skin and eye contact , irritation will remove natural fats from skin. Prolonged or repeated contact should be avoided, Otherwise skin chapping or cracking or possible contact of dermatitis may result. Dry skin, erythema oil acne and oil

folliculitis and warty growth may occur which may become skin cancer subsequently on excessive repeated exposure.

Emergency Treatment :

Inhalation - Remove victim to fresh air. Give artificial respiration if necessary. If unconscious but breathing, place in recovery (Unconscious) position and give external cardiac massage if necessary.

Ingestion - Do not induce vomiting. Remove contaminated clothing. Wash all affected skin thoroughly with soap and water.

Eyes – Irrigate eyes with copious amounts of water. Administration of medical paraffin may reduce absorption through digestive tract.

Gastric lavage should be done only after endo tracheal intubation in view of respiration which may cause serious chemical pneumonia for which antibiotic and cortico-steroid therapy may be indicated.

Handling and Storage Precaution :

Store in a dry cool, well-ventilated area away from heat and flame and keep away oxidizing agents.

Avoid contact with liquid or vapours. To use gumboots while handling the product.

The fire fighting media to be used is foam, DCP/CO₂.

TABLE 3.6 Requirements for Light Diesel Fuels ⁶:

Sr. No.	Characteristics	Requirements	Test Method [P:] of IS:1448
1	Acidity (inorganic)	Nil	[P:2]
2.	Acidity, Total, mg of KOH/g Max	Nil	[P:2]
3.	Ash, percent by mass, max	0.02	[P:4]
4.	Carbon Residue (Ramsbottom) percent residue, by mass, Max	1.5 (on whole sample)	[P:8]
5.	Pour point, Max a) Winter b) Summer	12°C 21°C	[P:10]
6.	Copper strip corrosion for 3 hrs. at 100°C	Not worse than No. 1	[P:15]
7.	Flash point, Pensky Martens, OC, Min	66	[P:21]
8.	Kinematic viscosity, cst at 40°C	2.5 to 15.7	[P:25]
9.	Sediment, percent by mass max	0.10	[P:30]
10.	Density at 15°C, Kg/m ³	To be reported	[P:16]
11.	Total sulphur, percent by mass, Max	1.8	[P:33]
12.	Water content, percent by volume, Max	0.25	[P:40]

Winter shall be the period from November to February (both months inclusive) and rest of the months of the year shall be called as summer. The values for maximum pour point and CFPP shall be those as directed by OCC from time to time.

Conforms to IS:1460-2000 specification for Diesel Fuels

⁶ Mr. Aman Singh Sales Executive IOC Pune.

3. Furnace Oil (FO)

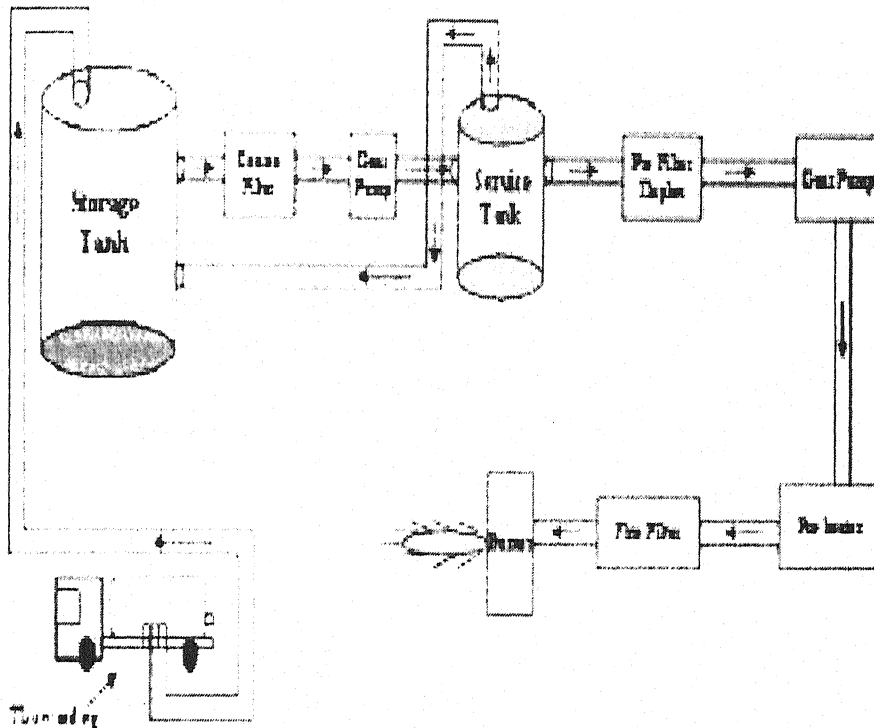
Furnace oil is a Dark, viscous residual fuel oil which is obtained by blending residual products from various refining processes with suitable diluent usually middle distillates to obtain the required fuel oil grades. These fuel oil grades are similar in nature and have been marketed under different specifications in various countries. In India it is sold under BIS specification under IS 1593-1982.

Furnace oil is a class C product having Flash Point above 66°C. Since this is a residual fuel, there has to be gradual filtration system to prevent the filter choking and fuel nozzles choking. Due to its viscous nature, it has to be heated to improve its flowability and to a proper temperature for proper atomisation. Normally gear pumps are preferred to avoid cavitation problems

Furnance Oil Storage – Petroleum Rules

As far as storage of Furnace Oil storage is concerned, the rules governing the same are less stringent when compared to more volatile fuels like Petrol, diesel etc.

GRAPH 3.1⁷



Uses of Furnace Oil are :

1. As fuel for Boilers/ Furnaces/ Air preheater/ Any other Heaters
2. Fuel for Bunkering
3. Fuel/ Feedstock in Fertilizer Plants

⁷ www.Hindustanpetroleum.com

As fuel for Power Generation in DG Sets

Form of Licence	Purpose for which granted	Authority empowered to grant licence	Fee
XVI	To import and store other wise than in bulk (a) Petroleum Class A in quantities exceeding 300 litres (b) Petroleum Class B in quantities exceeding 25000 litres (c) petroleum Class C in quantities exceeding 45000 litres or (d) partly one class and partly two classes of petroleum.	Controller	For each class of petroleum Rs. 1000 for the first 50 KI plus Rs. 15 for every additional KL or part thereof, for every calendar year subject to a maximum of Rs. 15,000 per calendar year or part thereof.

Safety Information :

- Reactivity Data - Chemically stable and incompatible with strong oxidizers. Does not React vigorously with common materials but can react with oxidizing agents
- Health Hazard Data - Routes of entry may be through inhalation/ ingestion/ skin/ eye.

Effects of Exposure /Symptoms :

Ingestion - may cause spontaneous vomiting, irritation of mouth throat and gastro intestinal tract.

On prolonged exposure it makes skin dry, erythema oil acne, development of warty growths which may lead to skin cancer, skin cracking and contact dermitites. As it is handled at a high temperature, skin contact could produce burns.

On exposure to eye it may cause light to moderate irritation. Ingested - do not induce vomiting as it may lead to chemical pneumonitis. Remove contaminated clothing immediately and wash affected area with water and soap. If eyes are affected, irrigate liberally with copious amounts of water and seek medical advice.

TABLE 3.7 Specification of Furnace Oil ⁸:

Sr. No.	Characteristics	Requirements Grade MV2	Test Method [P:] of IS:1448
1	Inorganic acidity	Nil	[P:2]
2	Ash, % wt. Max	0.1	[P:4] Method A
3	Gross calorific value, Cal/ gm	(typical 10000)	[P:6 or 7]
4	Density at 15°C	To be reported	[P:32]
5	Flash point (PMCC) °C. Min	66	[P:21]
6	Kinematic viscosity, cSt at 50°C	125-180	[P:25]
7	Sediment, % wt. Max	0.25	[P:30]
8	Sulphur, total % wt. Max	4.0	[P:33 or 35]
9	Water content, % v/v, Max	1.0	[P:40]
10	*Pour Point, °C, Max.	27	[P:10]

Handling and Storage Precaution :

Store in a dry cool, well-ventilated area away from heat and flame and keep away oxidizing agents.

Avoid contact with liquid or vapours. To use gumboots while handling the product.

The fire fighting media to be used is foam, DCP/CO₂.

⁸ www.oil.com

5. Low Sulphur Heavy Stock (LSHS)

Low Sulphur Heavy Stock (LSHS) is a residual fuel processed from indigenous crude. This fuel is in lieu of FO in the same applications where furnace oil is suitable.

The main difference with LSHS and FO is in the form of higher pour point, higher calorific value and lower sulphur content in LSHS. Presently it conforms to IS:11489-1985 grade I(enclosed).

As this fuel has higher pour point than that of FO it requires special handling arrangements. LSHS is handled hot at all stages and is maintained at 75°C. Special care is also taken so that no 'boil over' of the product takes place in the storage tank.

Sulphur Content - The main advantage in the use of LSHS lies in its low sulphur content. The life of equipment used is extended since the extent of corrosion both at high and at low temperature, is reduced very much. Apart from that, it is also advantageous from the environmental pollution point of view. Because it will emit lesser quantity of sulphur dioxide.

Calorific Value - The gross calorific value of LSHS is more than that of Furnace oil. So, the consumption of fuel oil will be reduced with the usage of LSHS.

Viscosity - LSHS is a low viscosity fuel oil at handling temperature when compared with Furnace oil. It is measured at 100°C.

Conforms to IS 1459 :1974 Reaffirmed 2001 Specifications for Kerosene

Safety Information :

- Reactivity Data - Chemically stable and incompatible with strong oxidizers. Does not React vigorously with common materials but can react with oxidizing agents.
- Health Hazard Data - Routes of entry may be through inhalation/ ingestion/ skin/ eye.

Effects of Exposure /Symptoms :

Ingestion may cause spontaneous vomiting, irritation of mouth throat and gastro intestinal tract.

On prolonged exposure it makes skin dry, erythema oil acne, development of warty growths which may lead to skin cancer, skin cracking and contact dermatitis. As it is handled at elevated temperatures, skin contact could produce burns.

On exposure to eye it may cause light to moderate irritation.

Ingested , do not induce vomiting as it may lead to chemical pneumonitis. Remove contaminated clothing immediately and wash affected area with water and soap. If eyes are affected, irrigate liberally with copious amounts of water and seek medical advice.

Emergency Treatment :

Inhalation - remove victim to fresh air. Give artificial respiration if necessary.

Ingestion - do not induce vomiting. Paraffin olive oil or some other vegetable oil may be given orally to retard absorption of Kerosene.

Gastric damage and induction and vomiting not advisable because of the possibility of the development of chemical from aspiration pneumonia of Kerosene

Handling and Storage Precaution :

Avoid contact with liquid or vapours. To use gumboots while handling the product.

The fire fighting media to be used is foam, DCP/CO₂.

TABLE 3.8 Specification of LSHS⁹ :

Sr. No.	Characteristics	Requirements Grade 1	Test Method [P:] of IS:1448
1	Pour point, °C, Max	66	[P:10]
2	Flash point, (PMCC), °C, Min	76	[P:21]
3	Kinematic viscosity, mm ² /s at 100°C, Max	To be reported	[P :25]
4	Sp. Gravity at 15°C	To be reported	[P:32]
5	Gross calorific value, cal/ gm	To be reported	[P:6]
6	Acidity, Inorganic	Nil	[P:2]
7	Ash, % by Mass, Max	0.1	[P:4] Method A
8	Sediment, % by mass, Max	0.25	[P:30]
9	Sulphur, total, % by mass, Max	1.0	[P:33]
10	Water content, % v/v, Max	1.0	[P:40]

Conforms to BIS specification IS:11489-1985

⁹ www.oil.com Oil India Ltd Website

6. Naphtha (LAN & HAN)

Naphtha is generally used as a fuel in Power Plants/ Petrochemical Plants/Fertilizer units and also for production of Hydrogen plants.

Power plants use High Aromatic Naphtha whereas other category of customers prefers to use Low aromatic Naphtha. However the categorisation of Low /High/ Mixed Naphtha varies with each Refinery. Fertilizer /Petrochemical industries also specify the aromatic content depending on the design of their plant. There is no BIS specification for Naphtha.

Safety Information :

- Reactivity Data - Chemically stable and incompatible with strong oxidizers. Does not React vigorously with common materials but may react with oxidizing agents
- Health Hazard Data - Routes of entry may be through inhalation, ingestion, dermal absorption and eye.

Effects of Exposure /Symptoms :

- Inhalation can cause unconsciousness which may go to coma.
- Ingestion : In mild form intoxication resembles drunkenness. Sometimes headache, lack of appetite, ingestion or while vomiting can cause systemic effects after repeated exposure.

- Skin and eye contact can cause irritation to the skin. Prolonged or repeated contact results in dry skin and development of dermatitis.

Emergency Treatment :

- Inhalation - remove victim to fresh air. Give artificial respiration if necessary. Remove contaminated clothing quickly.
- Ingestion - do not induce vomiting. Keep victim warm and quiet. Olive Oil or any other vegetable oil should be given orally to retard absorption of Naphtha.

Handling and Storage Precaution :

Store in a dry, cool and explosion-proof area. Avoid contact with liquid or vapours. Provide face sheets or safety goggles to protect eyes, plastic or rubber hand gloves, eye wash facilities.

It should be stored in closed container away from heat & source of ignition. As handling and safety precaution, avoid contacts with liquid or vapours and use personnel protective equipment. Sometimes flashback may occur along vapour trail.

The fire fighting media to be used is foam, DCP/CO₂. Do not use water jet.

TABLE 3.9 Specification of NAPHTHA – LAN¹⁰

Sr.No	Test	Method	Specification
1	Density @ 15°C, g/ml	P : 16	To be reported
2	Total Sulphur, %wt	P : 34 / IP : 336	Max.0.15
3	Residue on Evaporation, mg/100 ml	P : 29	Max. 5
4	Paraffins, %v	GC	Min. 65
5	Aromatics, % v	P : 23/GC	Max.11
6	Naphthenes+Aromatics, %v	P : 23/GC	Balance
7	Olefins, %v	P : 23/GC	Max. 1
8	Calorific Value, Gross Kcal/kg (Calculated)	P : 7	To be reported
9	Distillation IBP, °C	P : 18	Min. 34
10	FBP, °C		Max.180
11	Reid Vapour Pressure @ 38°C, psi	P : 39	Max.10
12	Lead as Pb, ppb wt.	ASTM D- 1368	Max.50
13	Colour (Saybolt)	P : 14	Min.+20
	Chlorides as Cl, ppmw	Appendix D	Max. 10

¹⁰ www.oil.com Oil India Ltd Website

TABLE 3.10 Specification of NAPHTHA (High Aromatic)¹¹

Sr.No	Test	Method	Specification
1	Density @ 15°C, g/ml	P : 16	0.682 to 0.75
2	Appearance	Visual	Clear & Bright
3	Colour	Visual	Colourless
4	Total Sulphur, %wt	P : 34 / IP : 336	Max.0.1
5	Residue on Evap. mg/100 ml	P : 29	Max. 5
6	Aromatics, % V	P : 23/GC	Max. 20.0
7	Olefins, % V	P : 23/GC	Max. 1.0
8	Calorific Value, Kcal/kg (Calculated) Gross	P : 7	Min. 11300
9	Distillation - IBP, °C - 50% recovered @ °C - FBP, °C	P : 18	To be reported Max. 130 Max. 180
10	RVP @ 38° C, psi	P : 39	Max. 10
11	Lead as Pb, ppm.	ASTM D- 1368	Max.0.2
12	K. V. @ 15°C, cSt,	P : 25	Min. 0.5

¹¹ www.oil.com Oil India Ltd Website

B. Industrial Lubricants

Bearing Lubrication

Compressors And
Exhausters

Gear Lubrication

Heat Treatment Of Metals

Heat Transfer Fluids

Hydraulic Equipments

Machining Of Metals

Railroad Oils

Refrigerators

Rust Prevention

Textile Machinery

Turbines

Special Applications

DG Sets

Earth Moving Equipment's

Greases

1. Bearing Lubrication

- Oils for Steel Mill Bearing
- Oils for Turbine Bearings
- Oils for General Bearing applications
- Oils for Sugar Mill Cane Crushing Bearing
- Oils for Bearings in Locomotive axles & Steel Plants
- Greases for Bearings
- High Temperature Grease for Bearings

The most common application of a lubricant is in bearings that are included in an endless variety of mechanical equipment. Two types are considered: plain bearings and rolling bearings.

Plain or Journal And Bush Bearings

When a journal rotates in a plain bearing that is receiving oil in adequate quantity, a fluid film of oil is built up by virtue of the viscosity of the oil as a result of rotation of the journal in the bearing. Under suitable conditions this oil film prevents metallic contact between the journal and the bearing, while frictional resistance to the movement of the journal depends mainly on the speed of rotation of the journal and viscosity of the oil under the conditions existing in the film. Friction may be reduced by using oils of progressively lower viscosities, but in every case, depending on speed and load, there is a lower limit of viscosity below which a fluid film is not fully maintained and metal-to-metal contact is likely to occur. In practice, therefore, it is usual to employ oils of sufficient viscosity to provide a safety margin. The effect of operating temperature on viscosity must not be

overlooked.

To ensure fluid film lubrication, the bearing must at all times be flooded with oil, so the oil must be supplied to the bearing at a rate equal to that at which it escapes. The rate of escape depends on the viscosity of the oil (less viscous oils escape more rapidly) and on such factors as bearing clearances and the mechanical condition of the bearing. Speaking generally, the greater the load, the lower the speed; or the larger the clearances, the more viscous the lubricant must be. Conversely, lighter loads, higher speeds and smaller clearance necessitate oils of relatively low viscosity. Viscosity requirement also varies directly with surface specifications and bearing mean pressures.

Cleanliness in handling and applying the lubricant is more important to reduce wear, and every precaution should be taken to prevent impurities and moisture getting into bearings. Correct alignment is also a matter of obvious importance in preventing overheating and wear.

Variation of factors referred above makes it necessary to provide a considerable range of machine oils of different viscosity, so as to give the most effective lubrication under all possible conditions.

Grease-lubricated plain bearings running at normal temperatures require general-purpose cup grease of medium-soft consistency. Moisture-resistant grease is generally preferable. Where operating temperatures are high, special high-temperature grease is required.

Antifriction Bearings

Anti-friction bearings consist of ball and roller type, needle bearings, tapered roller bearings etc.

- The main duties of ball and roller bearing lubricants are:
- To reduce friction between the rolling elements and the separator or cage, and between the rolling elements and the races at any point where true rolling is absent.
- To reduce friction between the ends of rollers and the guiding surfaces which form part of the inner or outer race.
- To assist in dissipating heat generated within the bearing.
- To protect the highly polished working surfaces of the bearing from corrosion and rusting.
- To assist in sealing the bearing against the entry of contaminants such as dust and moisture.

Ball and roller bearings may be lubricated by oil or grease, the choice of lubricant usually being decided by operating conditions and bearing design.

Oil Lubrication

Oil is generally considered to be more effective lubricant, and is to be preferred if the sealing arrangements are adequate, especially where the operating temperature or surface speed of the balls or rollers is high. Oils having viscosities ranging from that of the thinnest spindle oil to that of a heavy steam-cylinder oil are used. The viscosity required for any given set of conditions depends on size speed, load, and temperature of the bearing. Mineral oils of high quality should be chosen, because of their resistance to form resinous products, or acids which might damage the highly polished working surfaces of the bearing.

The method used to apply the oil depends mainly on the running speed of the bearing. Use of proper method is especially important with high-speed bearings, which are liable to overheat through churning of the oil if it is not correctly applied. The following means of application are suitable :

- Oil bath and splash systems - low and medium speeds.
- Circulating systems - medium speeds.
- Spray or mist - high speeds.

Over-lubrication should be avoided. As a general guide, with oil baths, it can be taken that the oil level should not be above the centre of the bottom-rolling element when the bearing is not rotating.

Grease Lubrication

The field of application of lubricating grease is related to their non-Newtonian characteristics. It is usual to employ grease as a lubricant where temperatures and speeds are not excessive and the sealing arrangements do not offer satisfactory lubrication by oils. In addition to being a lubricant, grease possesses excellent self-sealing properties and protects the bearing against the entry of contaminants, where the neck sealing is inadequate or elementary. The viscosity of grease at low or moderate rates of shear remains much higher than lubricating oil in general and so the bearing reaches hydrodynamic or full-film stage more rapidly than with oil.

However at high speeds frictional losses are relatively high and more frictional heat is also generated. Since the effectiveness of grease

as a coolant is limited, grease lubrication of plain bearings is therefore confirmed to units of low or moderate speed often under 200 rpm and rarely over 300 rpm; with journal surface speeds generally 1 to 2 m/s. This speed limit is however for large bearings of 50-cm. dia. or more. With reduction in size of the bearing the maximum journal surface speed upto which losses and heating are tolerable, fall sharply.

Calcium soap greases are mainly used where temperatures are moderate. Calcium-based greases are preferable for bearings that have to run in the presence of excessive moisture. Other types of greases are required where higher working temperatures and more satisfactory sealing properties are required than the conventional 'cup' greases. Such grades include lithium soap and inorganic-base greases and some soda soap greases, but it should be noted that Sodium soap greases are not recommended where the bearing is subjected to excessive washing by water.

Where loading is exceptionally severe for example, in roller-bearing assemblies fitted to the roll necks of a metal rolling mill, it may be necessary to use a grease with extreme pressure properties. Such greases are designed to give effective lubrication under conditions of shock loads and constant high loading. In certain applications they also require resistance to moisture; on a metal-rolling mill, for example, water is frequently used to cool the roll faces.

Whatever type of grease is used, it should have no tendency to separate under the operating conditions. When separation occurs, the oil runs out of the bearing and leaves behind dry soap that

hardens and cakes. This interferes with the movement of the rolling elements; overheating and mechanical failure may result. Excessive softening is also undesirable, because the grease might leak out of the bearing and leave the working surfaces unprotected.

The methods used to apply grease are governed by the design of the bearings and by conditions of operation. They are:

- Grease Packing - Applicable where periodic addition of fresh grease is not required.
- Compression Cup or Pressure Gun Application - Employed where the addition of fresh grease is periodically necessary.
- Centralized Pressure Systems - For severe service where the rate of consumption makes it necessary to add fresh grease at frequent and regular intervals (e.g. roller-bearing assemblies of roll necks of metal-rolling mills).

In selecting lubricants for ball and roller bearings, the needs of each application must be studied. Due regard must be paid to the type of bearing, method of lubrication and operating conditions. Thereafter, to ensure satisfactory operation in service, the main points to bear in mind are the exclusion of moisture, dust and other contaminants and regular replenishment or renewal of the lubricant. Care should be taken to avoid over-filling because this may cause operating troubles; for example, a bearing that has been tightly packed with grease is liable to overheat.

2. Gear Lubrication

Gear Oils

Gear Lubrication

Industrial gears may be either of the enclosed or of the open type. The enclosed type may be lubricated by splash, in which case the oil level in the gear box is maintained so that the teeth of the bottom wheel just dips into the oil. Alternatively a pressure circulating system may be used in which oil is sprayed on the teeth close to the point of engagement and is re-circulated either directly from the bottom of the gearbox or by the way of oil tank.

Splash lubrication is suitable where pitch line speeds are low, upto 5 m/sec for spur, helical and bevel gears and upto 4 m/sec. for worm gears. With splash lubricated gears it is most important that the oil level should not be too high, otherwise excessive churning of oil will occur with consequent rise in oil temperature and power loss. The depth to which the bottom wheel should dip into the oil, when stationary, is generally between 2 cms. to 4 cms. depending upon the size of the gear. Usually twice the tooth depth is sufficient for splash lubrication to minimise excessive churning. Where high powered gear sets running at high speeds are used, pressure circulating systems with oil coolers are preferred to reduce churning.

In the case of open gears the lubricant is generally applied to teeth by hand (brush). Alternatively dip shallow pool, automatic drip or spray methods (continuous or intermittent) can also be used.

The main functions of a gear lubricant are to reduce the friction and wear by providing a lubricant film between working surfaces of

meshing teeth and, in case of enclosed gears, to carry away the heat developed during tooth contact or meshing of gears.

To perform these functions properly, in cases where the conditions of tooth engagement are not abnormally severe and where straight mineral oils are suitable, the lubricant must be viscous enough to maintain the film and yet sufficiently free flowing to give adequate heat dissipation. These conflicting requirements are best met by oil as thin as is consistent with proper lubrication of teeth. It must be borne in mind that in most cases one oil is used not only for the gear teeth but also for the gear wheel and pinion bearings and that the bearings will tend to overheat with too thick an oil.

Where conditions of tooth engagement are particularly severe, as for example, in hypoid gears, the lubricant is unable by virtue of its viscosity alone to provide a film that can entirely prevent metal-to-metal contact between the teeth. In such cases it is necessary to employ extreme pressure lubricants. These lubricants contain chemical substances which at relatively higher surface temperatures developed at the points of metallic contact react with the metal of the gear teeth at these points to form solid or semi-solid films possessing anti-welding properties.

The use of greases in enclosed gears should be avoided in all but exceptional cases, because of their tendency to 'channel' and leave the teeth dry, also because of the possibility of their separating out and forming deposits in consequence of conditions existing in the gearbox. In addition, fluid friction tends to be higher with grease than

with oil of suitable viscosity and heat dissipation with the former is very low because of its

sluggishness. However, it may be necessary to use a grease for some enclosed medium and low speed gears where the box is not oil tight. For enclosed gears the lubricant is required to perform satisfactorily over long periods and high quality oils of good stability towards oxidation are therefore required. This is particularly so where conditions are such that aeration of the oil is pronounced for example, in high-speed gears or where operating temperatures are high.

Selection of the Oil

Enclosed Spur, Helical And Bevel Gears

In these gears the choice of oil mainly depends on the tooth loading and the pitch line speed. In general it can be said that higher the tensile strength of the gear material, higher will be the tooth loading and greater the required oil viscosity. It is also generally true that higher the pitch line speed, lower will be the tooth loading and less is the required oil viscosity. It is therefore practicable to use oils of low viscosity for high speed gears, which is desirable from the point of view of cooling and frictional losses also. Fluid friction and the heat produced by it, increase as the gear speed and oil viscosity increase. Lower viscosity oils are also preferable because they give better separation of water and other insoluble contaminants and have less tendency to foam.

Straight mineral oils are suitable for most gears of this type. In the case of turbine gears and similar high speed units employing a pressure circulating system, the use of a turbine oil with high resistance to oxidation is generally advisable. In certain medium and low speed applications, e.g. steel mill gears, where tooth loading may be abnormally high or where shock loads occur, straight mineral oils may allow a higher rate of wear than usual and fail to prevent some deterioration in the condition of the contact surfaces of the teeth. In such circumstances oil containing additives which confer additional load-carrying and anti wear properties, without having true extreme pressure properties, maybe used with advantage. As a rule extreme pressure lubricants are not required for gears of this type, though they may be recommended for some designs, e.g. spiral bevel units, where conditions of tooth engagement are liable to be severe.

Hypoid Gears

These are designed to transmit high power in proportion to their size. High degree of sliding, introduced due to offset of axles, along the line of contact between meshing teeth, coupled with the heavy loading generally associated with this type of gear makes lubrication conditions particularly severe and places an extreme requirement on the gear oil.

Straight mineral oils or oils containing relatively inactive additives of the anti wear type are inadequate and will generally allow severe scuffing to take place as these gears operate under boundary or mixed film conditions essentially all the time.

Hence lubricants containing active extreme pressure additives are invariably recommended for these gears.

Worm Gears

These are usually splash lubricated as these do not usually exceed a pitch line velocity of 4 m/sec, but if they do so, spray lubrication is essential. Owing to almost pure sliding between the teeth, worm gears generally run at a higher temperature than other types.

As worm gear efficiency depends upon the operating temperature, increase in temperature is a limiting factor for the power transmitting capacity of the worm gear unit. It is necessary to reduce tooth friction as much as possible by the use of comparatively heavy oils of carefully selected type. However, in order to limit the temperature rise due to churning, the viscosity selected should be lowered with increasing speed of gears. Normally straight mineral oils are preferred but, under high loading conditions, compounded oils may be advantageous notwithstanding their inferior chemical stability.

Open Gears

These are generally spur or bevel type and the lubricant is applied manually to the gear teeth.

A special type of lubricant with good adhesive properties is required to prevent its being flung off the teeth or being squeezed out.

These requirements are met by heavy, adhesive type, residual oils and greases. Heavy straight mineral residual oils need to be heated

or thinned with solvent before they can be applied to the gears. The solvent evaporates after application, leaving the teeth coated. The viscosity of the oil alone gives good protection to the gears. For improved load carrying capacity, oils containing extreme pressure additives are also recommended. Sometimes straight mineral oils are also compounded with fatty material to give improved field strength and to provide adequate lubrication where water is present.

Operating Troubles

Two sources of troubles directly related to lubrication in gear systems are high temperature and wear.

Excessive wear of teeth can result from misalignment or incorrect machining of the teeth; it may also result from the use of an oil of too low viscosity, which would not provide an adequate film of lubricant between the two contacting surfaces. In addition, oil starvation, or the pressure of abrasive impurities in the oil can cause high gear wear.

High temperatures may be due to any of the following causes :-

- Use of an oil of too high viscosity.
- Excessive churning of the oil because of the level being too high (this applies to splash lubricated types).
- Insufficient supply of oil to the teeth (where a force feed circulating system is employed), usually caused by the choking of oil pipes or oil strainer, causing high metallic frictional heat.
- Inefficiency of the cooling system, if one is provided.

Cleanliness is an all important factor if efficient and trouble free lubrication of gears is to be achieved. Special attention should be given to the thorough cleaning of any gear system before initial operation. Therefore, the oil should be purified regularly and renewed when necessary.

The range of lubricants for gear application marketed by Bharat Petroleum Corporation Limited suiting varied application is given below. For more information on the product click on the product name

3. Heat Transfer Fluids

Thermic fluid heaters are popular in Industry and are fast replacing steam boilers in certain applications because of the following advantages :-

- Exemption from Indian Boiler Regulations act and related formalities.
- No need for water treatment.
- No problem of scale deposition on heat transfer tubes.
- Safety from explosion hazards due to low operating pressures.
- Heating medium being a liquid, higher efficiency of heat utilisation can be achieved.

Selection

Right selection of thermic fluid is extremely important because it is this factor which profoundly contributes towards ensuring reliability of performance of heat transfer system. A good thermic fluid should have the following properties.

- The oil should be thermally stable.
- It must possess excellent oxidation stability.
- The oil should not have too much viscosity drop during its hot run hence should have sufficiently high Viscosity Index.
- The specific heat should not exceed 0.70 Kcal/Kg/°C at high temperature, as otherwise the thermic fluid may lose its heat rapidly.
- It should have a reasonably low pour point so that the system does not get wax clogged at low ambient temperatures.
- It must have low volatility characteristics.

Good corrosion preventive properties.

4. Machining Of Metals

Cutting fluids, of which cutting oils are by far the most important type, are liquids applied to the tool and material at their point of contact during machining. They facilitate the machining operation in various ways. In the first place they keep the tool and work piece cool. This reduces the rate of wear of the tool, and - by preventing excessive expansion - it simplifies the task of machining the work piece to the exact final dimensions required. Secondly, cutting fluids reduce power consumption by their lubricating properties. Thirdly they prevent welding of the chip to the tool, an effect which is liable to occur when tough materials are machined. They also have various auxillary effects such as improving surface finish, washing away chips and acting as protectives against corrosion.

Cutting fluids are divided into three main classes, 'soluble' oils, 'neat/straight' oils and 'water-base' fluids. Soluble oils are emulsifiable with water and are normally used in the form of aqueous slurries. The main types of straight cutting oils are extreme pressure (EP) oils, which are designed for neat use. Water-base fluids are true solutions of salts and other materials in water.

The properties required in a cutting fluid depend on the operation. For rapid, light machining such as turning and grinding, cooling power is usually more important than the lubricating power, but the reverse is true of slow, heavy operation such as broaching. Soluble oil slurries and water base fluids have greater cooling power but less lubricating power than straight oils, consequently there is a tendency to use them for light operations and straight oils for heavy work. This

general rule is, however, considerably modified by various other factors, such as the type of metal being cut and whether the operation is roughing or finishing.

Soluble Oils

These oils form stable emulsions with water. (Strictly speaking the term 'soluble' is a misnomer, because emulsions are not true solutions). These are opaque and clear types of soluble oil. The opaque type forms a milky-white emulsion, which does not permit a clear view of the job allowed by the clear-type, the translucency of which is of special value in precision work.

The following points concerning the storage and use of soluble oils are important.

Storage

Exposure of packages to moisture or to excessive heat or cold should be avoided.

Mixing

To make the emulsion, add the necessary quantity of oil to the water (never the water to the oil), meanwhile stir constantly. Do not use hot water or steam. Use absolutely clean vessels.

Hard Water

The use of excessively hard water to make emulsion may cause separation of emulsion, possibly followed by rusting of the work piece or machine tool. This can be avoided by softening the water

(upto 40 ppm CaCO_3 is adequate) before making up the emulsion. A simple method of doing this is by adding washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) according to the following formula :

$W = (H-40) \times 12.76$ gms per 4500 litres of water.

where W = Weight of Washing Soda in gms.

and H = Hardness in terms of parts per million of calcium carbonate.

It is best to add the soda in a separate tank and draw the water for the emulsion from the top after the precipitate has settled.

Maintenance Of Emulsion

During use, the concentration of oil in the emulsion becomes lower because more oil than water adheres to the metal shaving & finished parts. It is therefore, necessary to make additions to maintain the strength of emulsion. This is done by adding concentrated emulsion prepared separately for the purpose. To know how much of this to add, the strength of the impoverished emulsion should be measured. A way of doing this is, to add 10% by volume of strong Hydrochloric acid to a quantity of the emulsion in a measuring glass. The acid breaks up the emulsion, the oil rises to the top and the amount can be read off. From this the required percentage of oil to water in the concentrated emulsion can be estimated.

Application Of Slurry

In applying the emulsion it must be directed on to the work in an adequate stream. It must not form a spray, nor contain air bubbles formed in the circulating system.

Extreme Pressure Straight Cutting Oils

Heavy operations in modern machining practice have led to important developments in cutting fluids. Lubrication by a fluid film of oil becomes impossible in these operations because of high temperatures and pressures involved. Lubricants, able to prevent the welding and to reduce friction under these conditions have consequently been developed. These lubricants consists of mineral oils to which certain chemically active substances have been added. At high temperatures which are developed where the metal chips press against the tool, these substances attack the metal to form an extremely thin film of a chemical compound which prevents the tool and chip from becoming welded together. Various compounds of sulphur and elementary sulphur itself, are the additives most generally used to produce this result. Certain compounds of chlorine are also used to a considerable extent.

Some E.P. cutting oils are black and this is a rather troublesome feature because the work is hidden from the operator. It is possible, however, to prepare transparent types which are much more convenient to use. E.P. cutting oils have much lower cooling power than soluble oil emulsion because their specific heat is only about half that of water. But, because their lubricating power is much higher, less heat is developed and cooling is consequently less important.

In addition to having high lubricating power, good transparency and stability, these oils must also be sufficiently fluid to be easily pumped and to drain away readily from the metal cuttings so as to avoid

waste. These considerations impose an upper limit on the permissible viscosity.

Water Base Fluids

These are aqueous solutions of chemicals which are diluted further with water before use. Soda solutions were amongst the first cutting fluids used many years ago - and they are still used to a small extent. However, during the past few years, interest has arisen in fluids containing sodium nitrite, which has become prominent because of its rust-preventive properties.

At present there are indications of two distinct lines of use for water-base fluids. The more common use is in grinding operations, where they are used at concentrations of 1:80 or less and where, depending on operating conditions, they can show distinct advantages over clear soluble oils, they remain clear for longer periods, reduce loading and wear of wheels and provide more rapid removal of swarf from coolant systems. Less commonly, fluids of this type are used, at concentrations of 1:20 to 1:40, instead of soluble oils for such operations as turning, drilling, milling and sawing. Apart from advantages of cleanliness and clarity, there are indications that better cutting performance can be obtained with certain water-base fluids; moreover, some success has been achieved with such fluids in the machining of cast iron, an application in which soluble oils have generally shown little advantage.

5. Refrigerators

The reciprocating compressor is by far the most usual type employed in refrigeration installations. Such compressors may be vertical or horizontal, single-acting or double-acting and the crankcase may be opened or enclosed. Lubrication is by methods generally used for reciprocating machinery. In trunk piston types the cylinders are splash lubricated, with supplementary direct feed in some instances; in crosshead types oil is supplied separately to the stuffing glands and to the cylinders. In the latter case the oil may be led into the gas suction pipe or, more commonly, delivered direct to the cylinders and glands.

Bearing lubrication of open-crankcase machines presents no feature peculiar to refrigerators and the following notes, are therefore, concerned with cylinder lubrication and with the bearing lubrication of trunk piston machines, where the oil comes into contact with the refrigerant. Although the functions of a refrigerator compressor lubricant are the same as those of compressor lubricants in general, conditions of service in refrigerators impose additional demands on the oil. The reason for this is close association between the refrigerant and lubricant. Oil is unavoidably carried into the circuit with refrigerant discharging from the compressor. In many installations provision is made for the removal of this oil, nevertheless, some oil is liable to reach the cold parts of the system. On the other hand, with many of the Freons-especially Freon 12, oil which enters the system is difficult to separate and is commonly allowed to circulate with the refrigerant, such refrigerants can be regarded as oil-miscible. In either case the behaviour of oil in cold

parts of the system is important. The properties that have to be considered here are low pour point and low wax-forming tendencies.

It is essential to use an oil that will not congeal in the evaporator and in other cold parts of the system. Low pour point is important principally where the refrigerant and oil are not completely miscible in the low temperature region. This is the case, for example with ammonia or carbon-dioxide, which for practical purposes may be regarded as immiscible with mineral oil. Even so, experience has shown that refrigerators with these refrigerants will function satisfactorily at temperature below the pour point of oil. With a few exceptions, including Freon 22, the halogen refrigerants may be regarded as completely miscible with oil in the normal working range and pour point of the mixture is considerably below that of the oil. Under such conditions the pour point of undiluted oil is of relatively little importance. However, mineral oil is a complex mixture of hydrocarbons which have different solubility characteristics; accordingly, whilst the bulk of the oil may remain in solution, certain constituents may separate out at low temperatures and form wax-like deposits. A further requirement of a refrigerator oil therefore is low tendency to wax formation.

Because of the efforts made to eliminate air from the system, refrigerator oil is unlikely to be subjected to severe oxidation. Nevertheless, the presence of some small quantity of air is unavoidable & this may provide a starting point for deterioration. Moreover, deterioration of the lubricant is bound to be more with chemical reactions which may involve moisture and other impurities, construction materials and the refrigerant itself. For example, some

refrigerants are liable to form corrosive acids in the presence of moisture. Under such conditions unsuitable oils are liable to thicken and form gummy deposits and sludge. Adherent deposits are liable to cause excessive wear and inefficient operation of the compressor, particularly through piston ring-sticking and interference with operation and seating of valves. Seizure may occur in extreme cases.

The foregoing are instances of the undesirable effects that may occur. It is found in practice that under normal conditions these effects can largely be eliminated by using oils possessing chemical stability of a high order and avoiding contamination.

In all cases the rate of supply of oil to the compressor cylinders must be the minimum required for proper lubrication. Where oil and refrigerant are mutually immiscible all excess oil must be removed from the system to reduce accumulations of congealed oil in the system. Where oil-miscible refrigerants are used, dilution of oil reduces viscosity of the resultant mixture and viscosity of the oil must be high enough to afford satisfactory lubrication under such conditions. In all cases, however, viscosity of the oil used must not be so high that the oil is unable to penetrate fine working clearances to all surfaces where it is required. A further factor limiting viscosity is that some increase of viscosity at lower temperatures is inevitable and removal of oil from cold parts of the system becomes increasingly difficult with oils of greater viscosity. In general, refrigeration compressor cylinders require relatively light oils.

Consideration must be given to the requirement of all refrigerators that the refrigerant and the installation in general must be free from moisture. The presence of water leads to obstruction of the system by accumulations of ice and apart from the possible formation of corrosive acids, with some refrigerants it may form solid refrigerant hydrates.

Summarising, oils for 'internal' lubrication of refrigerators require the following

characteristics :

- Ability to maintain a lubricating film at high temperatures and remain fluid at low temperatures.
- Low tendency to wax deposition at low temperatures.
- High chemical stability.
- Appropriate viscosity.
- In operation the following points should be remembered:
- The rate of oil supply to the cylinders should be kept to a minimum.
- Oils should be removed from the oil separators regularly.
- The system should be kept entirely free from air and moisture.
- In the case of trunk-piston compressors, the oil should be withdrawn and filtered regularly to remove foreign matter which may have gained access.
- Discharge gas temperature should be carefully watched as an index of efficient operation.

Conditions which may lead to high temperature are :

- Faulty valve operation causing wire-drawing.
- Worn rings or cylinder liners, in the case of double-acting compressors causing recompression.
- Gas entering the suction valve in superheated condition.
- Too much refrigerant in the system.
- Presence of foreign gases in the system.
- Inefficiency of the condensor.

6. Textile Machinery

In the lubrication of the textile machinery, special consideration has to be given to keeping down power consumption, protection against the corrosion and avoidance of staining of yarn or fabric.

Power Consumption

In all machineries, a certain amount of power is expended in overcoming friction within the lubricant film itself. The proportion of the total power thus consumed tends to be high in high speed machinery with a large number of lightly loaded bearings. Friction of this kind is largely a function of the viscosity of the lubricant; being naturally greater with thick oils than with thin. To conserve power, it is important to use an oil of the lowest viscosity compatible with satisfactory lubrication and other considerations concerned with splashing and oil consumption.

Oxidation tends to cause thickening of oils in service, so it is advantageous to use good quality products of high oxidation stability. The viscosity of such oils does not alter greatly even on prolonged use.

Protection Against Corrosion

Where the atmosphere is humid or in other conditions conducive to corrosion, the lubrication should be capable of providing adequate protection. This is especially necessary for ball and roller bearings, which are very sensitive even to incipient corrosion. Protection of the highly polished parts such as knitting needles is of equal importance

The danger of corrosion can be greatly reduced by using suitable lubricants of high quality. Oils specially treated to have good anti-rusting properties are available for use under difficult conditions.

Staining

The oil has to be carefully chosen where there is a risk of the yarn or the woven material being stained by the lubricants as a result of oil throw or leakage.

Staining can be reduced by sparing application of the lubricant and by employing appropriate viscosities. In some cases it is an advantage to use oils with special stringiness and non-drip properties. It is usually possible to avoid the objectionable consequence of staining, by using oils which can be readily removed by scouring or where scouring is not permissible, highly stable colourless oils.

It must be borne in mind, however, that oil spots on fabric tend to collect dust or other impurities and that they constitute a source of staining on this account. Naturally this applies especially in the absence of scouring process. Where scouring is carried out it is advisable to perform the operation with as little delay as possible, although suitable oils can be removed by scouring, impurities collected during storage may be responsible for staining.

Applications

Some individual applications are considered below. These examples are chosen because of their importance or special features.

Spindle

Spindles run at high speeds and consume a large part of the power required to drive a spinning frame. Attention must therefore be paid to use an oil which is of appropriately low viscosity and which will not thicken in service. There are two main designs of spindle ---- the oil bath types fitted to ring frames, speed frames, and on certain types of bobbin winding machines and the open type found on such machines as mule frames.

In ring spindles the lower portion of the spindle extends through a guide bearing into a narrow oil bath, the pointed base of the spindle being supported in a step bearing. In modern designs the guide bearing is usually a rolling bearing. Speeds may be 11,000 to 12,000 r.p.m. or even higher. Higher quality oils are particularly necessary for this application, because the small quantity of oil that is used must serve without undue thickening for a considerable period. Protection against corrosion is also important, especially for ball or roller bearing inserts. Special high quality oils are available which have been treated to embody exceptionally good stability together with antirust and dispersant properties. These oils have been developed to prevent deposit formation on the spindle blades and in the inserts and bolsters.

The use of open type spindles is declining and the bath-lubricated spindles are now taking their place, similar to the ring spindles mentioned above, and by spindles with oil impregnated bearings and grease lubricated rolling bearings. There are, however large numbers of open type spindles in use and it will be many years before they are eliminated. The lubricant is normally applied by hand. To counteract leakage from the bearings, oils of higher viscosity are used for this

type of spindle and fairly frequent application of the lubricant is necessary particularly to the guide bearings. Both straight mineral and compounded oils are used. The latter offers an advantage in that their greater oiliness provides a measure of lubrication under starved conditions and they are particularly useful for worn guide bearings. They should not be necessary, however, for spindles in good mechanical conditions and when lubrication is regular.

Top Rolls, Roll Stands And Saddles

Lubrication of these, is generally by hand. Proximity of the yarn as it passes between the rollers makes it important that over lubrication be avoided both to prevent staining of the yarn and to avoid damaging the leather covered top rollers. A compounded oil or soap thickened lubricant is normally recommended.

Winding Machines

High speed winding by quick traverse machines is widely employed. Lubrication of the gears and traverse cam assembly is normally by splash. Considerable churning of the oil takes place, therefore the use of an oil of high quality is desirable which prevents troubles due to oil thickening and sludging.

Sizing Machines

The steam heated drying cylinders may be mounted on either plain or ball bearings. Use of the latter reduces friction and the tension on the warp thread, particularly on starting from rest. According to design these bearings may be lubricated either by grease or oil and because heat is conducted to the bearings from the steam passing through the hollow cylinder shafts the high temperatures involved must be

considered when the lubricant is selected. Where oil is required it should be of high viscosity. Highly refined oils are recommended so as to avoid the troubles from carbonisation of the lubricant. For grease lubrication heat stable greases are available.

Looms

Low speeds and high bearing loads compared with those in the majority of textile machines are normal in loom operation. Because of sharp jerky motion of the weaving operation, the risk of the lubricant splashing onto the fabric is considerable, particularly with Jacquard or other types of overhead motion. Oils possessing stringiness and scourability are recommended.

Knitting Machines

Lubrication of these used to be almost entirely by hand, using an oil can, a brush or a hand spray, but there is now an increasing tendency to lubricate the knitting mechanism with small mechanical lubricators which can control the supply of oil to a minimum. Over lubrication is to be avoided, to reduce splashing to a minimum. The machinery because of its delicate and intricate nature, is sensitive to impurities. These maybe extraneous matter or degradation products of oil itself. Good quality oils are therefore preferable, to avoid trouble through formation of gummy deposits. In addition to lubricating the working surfaces of the machine itself, the lubricant must protect the highly polished surfaces of the knitting needles from corrosion an important requirement in view of the humid atmosphere in which machines of this kind usually operate. Scourability and alternatively non staining characteristics; depending on whether or not scouring is

permissible, are the further important requirements for this application.

7. Special Applications

- Rubber Processing Oils
- Ingot Mould Oil
- Machine Tool Way Oils
- Pneumatic Tool Lubrication
- Steam Cylinder Lubrication Oils
- Cab Body Drawing Operation
- Once Through Lubrication System Lubricant
- Special Application Greases

There are some special application which need custom made lubricants to suit the unusual requirements of these special application. Some of the more important application and the product suiting the application requirements are given below

Rubber Processing Oil

Rubber mastication during the initial processing of rubber requires a medium to facilitate mixing operation and improving processability of the rubber.

Ingot Mould Oil

Coating the inside of steel ingot mould with this oil facilitates easy release of the ingots and to prevent blow-holes

Machine Tool Way Oils

Special tableway oils designed for lubrication of the machine tool slides and tables

Pneumatic Tool Lubrication

Special Oils to meet the requirements of percussion type pneumatic tools in general and rock drills in particular.

Cab Body Drawing Operation

Special Oil to provide improved surface finish and increased die life in car body drawing application

Once Through Lubrication System Lubricant

General purpose oils for once through lubrication system in non critical industrial machinery application

8. Earth Moving Equipment's

- Oils for Off Highway Engines
- Oils For Transmission in Earth Moving Equipment's

Bharat Grades for Earth Moving equipment application [click here](#)

Earth moving equipment's are used in construction and mining operations for excavation purposes. The common ones are bulldozers, dumpers, loaders ,scrapers, shovels, graders, draglines and trucks.

Diesel engine power is used almost exclusively, having single engines developing as high as 400hp. Twin-engine designs of tractors and loaders are available with higher hp. Superchargers have been used to boost the hp even further.

Torque convertors are in wide use to transmit power from engine to the drive system.

Hydraulic systems for actuating the various movable parts such as blades, buckets and scraper bowls are used widely giving better control and smoother operation.

Trucks vary from standard heavy-duty highway equipment to giant off-highway units. Both rear dump and tractor trailer types are used. Common capacities are 22 to 34 tons. But higher capacity trucks of 50 tons or more are also used. Horse powers have also increased tremendously and upto 600hp rear dumpers are seen. Turbo superchargers are being used and torque convertors, power brakes, power steering are standard equipment.

Lubrication

The type of lubricants required varies with each manufacturer's recommendation. But the major lubricants used are as follows:

- Diesel engine oil
- Hydraulic transmission oil
- Automatic transmission fluid
- Gear box oil
- Brake fluid
- Grease

9. Compressors And Exhausters

- Compressor Oils
- Amonia Compressor Oils

Compressor Lubrication

Compressors are of two main types : Positive displacement and Turbo type. Positive displacement compressors are either reciprocating or rotary.

Reciprocating Compressors

These are most commonly vertical or horizontal and are almost invariably equipped with automatically operating spring loaded inlet and discharge valves. Delivery pressures range from comparatively low pressures of the order of 1.4 kg/sq.cm. to the highest required in practice.

When a gas is compressed under practical conditions its temperature increases, the difference between delivery and suction temperatures being a function of the compression ratio. When high pressures are required, compression is carried out in stages. Gas temperatures are reduced by cooling the cylinder walls and by passing the gas through intercoolers between successive stages and frequently through an after cooler as well. A compression ratio of about 4:1 in each stage is usual.

Small single-stage trunk piston compressors are frequently splash lubricated, whereas larger units of this type are generally equipped with forced circulation systems. Cylinders of cross head type

compressors and multi-stage compressors are generally lubricated by separate oil feeds to the suction pipes or directly to the cylinder walls.

For cylinder lubrication it is desirable to use an oil of high stability. In the presence of air, or even where relatively inactive gases are concerned, a non-stable oil will tend to breakdown under the prolonged influence of elevated temperatures and form gummy deposits which may cause piston rings to stick and may affect the action of valves. It is usual to employ straight mineral oils for cylinders, but if the compressor is dealing with very moist gas, a compounded oil may be preferable to counteract the washing and rusting effect of the moisture. Compounded oils are, however, generally unsuitable for crankcase lubrication and in trunk-piston machines fully detergent diesel engine oils may be preferable with moist gas. These oils may also be desirable for cylinder lubrication under high temperature conditions.

Use of viscous oils should be avoided wherever possible, for the reason that they tend to give rise to greater drag on the pistons and more deposit formation than thin oils. Oils of relatively low viscosity are suitable under most conditions. In certain multi-stage compressors, however, where temperatures are consistently above 1400 C and it is essential that the air or gas discharging from the compressor should be contaminated as little as possible with oil vapours, it may be necessary to use more viscous oils of a special type.

The following important points should be borne in mind in the operation of reciprocating compressors :

- Only high-grade oils should be used. The rate of oil feed should be kept to the minimum. If this precaution is not observed there is a danger that oil droplets will accumulate on the discharge valves and form deposits which may interfere with the action of the valves or drawing of the gas will occur with consequent rapid rise in temperature. The same effect is, of course, produced by badly fitting discharge valves.
- Effective filters should be fitted to prevent the entry of dust, grit and other foreign matter.
- Condensed moisture should be removed regularly from the inter coolers.
- Coolers should be kept free from scale or other deposits which would interfere with their efficiency and all gas and water connections should be kept tight.
- Piston crowns, piston rings, valves and all passages between the cylinders and receiver should be cleaned periodically.

Positive Displacement Rotary Compressors and Exhausters
Positive displacement rotary compressors are used in applications overlapping those of both reciprocating and turbo types. Similar units are built for service as exhausters.

There are two main classes of positive displacement rotary machines : the sliding-vane and the two-impeller types.

Sliding-Vane Compressors

These machines are used for supplying relatively large quantities of air or other gas at moderate pressures (upto about 8.8 kg/sq.cm.). Single-stage machines generally deliver at pressures upto 3.5 kg/sq.cm. Two-stage machines are used for higher pressures. Speeds range from about 450 r.p.m. to 4000 r.p.m.

The machine consists essentially of a cylindrical rotor carrying a number of thin rectangular plates or vanes in radial slots. This rotor assembly is supported eccentrically in a cylindrical water-cooled or air-cooled casing by ball or roller bearings housed in the end covers. When the rotor revolves the vanes are thrown out by centrifugal force, thereby dividing the space between the rotor and casing into a number of compartments of different sizes. The size of each compartment increases to a maximum during one half revolution and decrease to a minimum in the following half revolution. Air or other gas is drawn in by an intake port arranged so that the compartments may fill with air until they reach their maximum size. A discharge port is arranged further on in the cycle, just before the volume of the compartments reaches the minimum.

In some sliding-vane compressors the outward thrust of the vanes is borne by two 'floating rings' fitted in annular recesses in the casing on each side of the inlet and discharge ports. These rings are carried round with the rotor and prevent the blades from scraping over the casing bore. In one type of sliding-vane compressor a cylindrical line or 'rolling drum', mounted on ball bearings is fitted over the whole length of the blades. Gas enters the suction side and leaves the discharge side through holes in the rolling drum.

Oil is fed to the rings, to the inside of the casing and to the rotor bearings of the floating-ring types. In the rolling-drum type oil is forced along an axial hole drilled in the rotor shaft centre from which it is thrown out by centrifugal force and reaches all internal parts, including the vane slots. Somewhat thicker oils are required for orthodox sliding-vane machines than for the cylinders of reciprocating machines. This is necessary partly to reduce friction and partly to improve the seal. Heavy oils, sometimes with enhanced antioxidant and detergent properties are required in certain cases where high air temperatures are developed.

In oil-cooled sliding-vane compressors large quantities of oil are injected into the rotor chambers. In this way the oil, in addition to providing effective lubrication and sealing of the moving parts, also ensures efficient cooling of their air during compression. The oil is intercepted on the discharge side of the machine, cooled, filtered and then re-circulated. The operating conditions are severe. During circulation most of the oil is exposed in a finely divided state to large volumes of hot air and although the air discharge temperatures are comparatively low, the oil is subjected to severe oxidizing conditions. Moreover, particularly when the machine is idling, overcooling can lead to the condensation of moisture in the oil receiver where it mixes with the oil to form an emulsion. Should the quantity of condensed moisture become excessive, rusting and consequent blade wear may occur. It is essential, therefore, that the oil should have excellent oxidation stability and good demulsibility. On this basis, the best choice will be an oil of turbine quality.

Screw Compressors

These are widely used in the process industry for gas compression. They are similar to the two impeller compressors. They have two intermeshing rotors with helical lobes which are designated as male and female. When the male and female rotor lobes engage, they form a cell in which the air is enclosed. As the rotors rotate the volume of the cell is reduced and compression begins. Further rotation causes the line of engagement of the rotors to travel towards the outlet, with the result that the air is displaced from the cells under pressure.

Single stage machines are generally able to generate pressures upto 5 kg/sq.cm. while multistage machines upto 12 kg/sq.cm.

Screw compressors present the same lubrication requirements as Blowers. However the bearings of these compressors are usually more heavily loaded and therefore require additive type oils.

Turbo Compressors

This term covers two distinct types - centrifugal compressors and axial flow compressors. Units of both types are employed for delivery of large volumes of air at moderate pressures (generally upto 7 kg/sq.cm.). Operating speeds are usually in the range of 2000 to 10000 r.p.m.

A centrifugal compressor consists essentially of a casing in which a shaft carrying one or more impellers rotate. Gas enters each impeller at the centre and under centrifugal force, is expelled peripherally at high speed. Pressure increase is obtained by reducing the kinetic

energy of the gas in a static diffuser. Multi-stage compression is obtained by directing gas from each diffuser into the eye or hub of a further impeller.

The main application of axial-flow compressors is in conjunction with gas turbines. These compressors resemble reaction turbines in reverse, each stage comprising a row of fixed and moving blades. Compression takes place both in the fixed and moving blades, gas flow being in an axial direction.

Both types of turbo compressors are generally fitted with plain bearings, lubrication being by forced circulation. Where the compressor is coupled to a steam or gas turbine a common circulating oil system is employed. Small centrifugal machines are commonly fitted with ring oiled bearings.

Two-Impeller Compressors Or Blowers

The commonest application of compressors of this type is for diesel engine supercharging. They are used also in various industrial applications where machines of relatively large capacity, delivering at low gauge pressures are required. Single-stage units generally deliver at pressures below 1 kg/sq.cm. Similar machines with fine operating clearances may be used as vacuum pumps.

A two-impeller compressor consists essentially of a pair of lobed rotors mounted on parallel shafts rotating in opposite directions. The rotors engage each other, clearance between them only a few thousandths of an inch being maintained by accurately cut timing gears. The rotors usually have two or three lobes. Air enters the

machine through an inlet port so placed, that as the impellers rotate, air is trapped between adjacent lobes and the casing. On the other side of the casing air is forced out under pressure through the discharge port.

Small machines of this type are fitted with grease-lubricated roller bearings or ring-oiled plain bearings, the timing gears being bath lubricated. Large units may be fitted with a forced circulation system for bearings and gears.

10. Heat Treatment of Metals

- Heat Treatment Oils

Heat Treatment of Metals

The term heat treatment, as applied to metals, refers to any type of thermal operation to which they are subjected with the objective of modifying their physical properties. It therefore covers such varying processes as, annealing, normalising, hardening, tempering and stress relieving. Of all the various heat treatment, however, only two make use of oils to any important degree. These are hardening and tempering of steel.

The hardening of steel involves heating it to a certain minimum temperature above what is called its critical range (characteristic for each steel) and then cooling it rapidly (quenching) in some suitable liquid. A special hardening process now becoming important is marquenching. Tempering consists of reheating the hardened steel to some temperature below the critical range, maintaining the temperature for a period, then cooling it again, usually in air. Occasionally the cooling is done more rapidly for example, in water. The objects of tempering are to relieve the stresses set up by hardening and to increase the toughness of the steel by reducing the hardness lightly.

Hardening

Water and oil are the two quenching media which are most extensively used. Brine is sometimes employed to harden steels for which water alone is not quite fast enough and at the other end of

the scale, there are certain alloy steels, the 'air hardening steels' which as the term implies, are hardened by simple air cooling.

All quenching operations subject the metal to considerable stresses and cause distortion to a degree which other things being equal increases with the severity of the quenching medium used. For this reason it is axiomatic in heat treatment work to use the mildest quenching medium that will give the desired hardness.

Because oil gives a milder quench than water, it is used very widely for the hardening of alloy steels, for such steels do not, in general, need the more rapid quench given by the water. Moreover, many of them, because of their relatively low heat conductivity, would crack if they were water quenched.

Plain carbon steels need the rapid quench given by water to develop maximum hardness. Oil quenching, on the other hand, gives an adequate degree of hardness for many applications and is used to considerable extent for plain carbon steels of all carbon contents.

An important difference of practical significance between water and oil as quenching media is that the quenching power of water falls rapidly as its temperature is raised, whereas that of oil remains fairly constant. Thus at 34 to 400C water gives a much slower quench than at 200C, but the quenching power of suitable oil over the same range of temperature and upto the range 60 to 800C, remains more or less constant. This is because with an oil, the temperature rise produces drop in viscosity, a change which assists cooling and so offsets the reverse influence of rise in temperature itself. There is, of course, no such compensating effect with water.

The behaviour of quenching oil may be modified by the incorporation of additives and may be affected by the presence of contaminants; primarily, however, it is determined by the physical properties involved in the successive stages of cooling, which are specific heat, thermal conductivity, latent heat of evaporation, boiling point or range and viscosity.

Mineral oils vary in type, the differences between them being reflected particularly by the rate of change of viscosity with temperature. However, in all types of oil the specific heat, thermal conductivity and latent heat are much the same. From the aspect of quenching power, volatility and viscosity are the main factors governing the selection of an oil for quenching.

Volatility and viscosity are interrelated because for oils of the same class a higher viscosity is usually accompanied by higher boiling range. To a large extent the differences in performance between oils of different viscosities are really due to their differences in volatility. However, viscosity of oil itself is of some importance here; increase in the viscous resistance to flow tends to hinder convective turbulence in the oiling or vapour transport stage. The latter effect is, within limits, advantageous because it reduces the risk of cracking, but the effect of the vapour transport stage is to reduce the quenching power of the oil. An upper limit of viscosity therefore has to be set. A lower limit of viscosity derives from the limit that has to be set to the volatility of the oil.

An important consideration in oil quenching is chemical stability of the oil. When red-hot steel is plunged into the oil some oxidation of

the oil is inevitable and in the course of time the resulting changes are bound to cause thickening of the oil and formation of the sludge. Oils of inadequate stability will suffer excessive rapid degradation. A certain standard of quality is needed to avoid this.

Flash point is of little significance in a quenching oil. The bath is maintained at a relatively low temperature (about 800 C maximum) which is far below the flash point of any oil suitable for the quenching. Moreover, the red-hot work piece is rapidly immersed and is then surrounded by a jacket of oil vapour containing no air, so combustion cannot occur. In addition, the surface temperature of the work piece falls very rapidly to safe value.

Accelerated Quenching

As stated above, plain carbon steels are normally quenched in water but are sometimes quenched in oil when the degree of hardness so obtained is adequate for the application in view. Except with very small pieces, oil quenching entails a considerable sacrifice in hardness. Plain carbon steels and steels of low alloy content belong to the class known as shallow hardening steels. This means that the quenching rates necessary to harden them are so high, that in specimens above about 1.5cm in diameter, only a shallow surface layer reaches full hardness; below this hardness rapidly falls. With the accelerated quenching oils, however, this falling away, though still present, is less rapid than with a normal quenching oil; sometimes the surface hardness is also increased.

The use of accelerated quenching oil is mainly beneficial with small work pieces, up to about 5cm. in diameter; with large work pieces

the cooling rate is governed by the rate of heat flow through the steel and not by the rate of heat removal from the surface.

The increased speed of quenching obtained with accelerated quenching oils is obtained by the incorporation of special additives.

Marquenching

Marquenching involves quenching steel in hot oil, holding it in the quenching bath until the temperature throughout the work piece becomes uniform, and then cool in air. The main advantage of this process over normal quenching is that it reduces distortion and cracking.

The oil baths used in marquenching are maintained at a temperature usually in the range of 1500C to 2000 C. For use at temperatures of this order it is essential to use a special oil of high flash point, low volatility and high oxidation stability.

Tempering

Steels are tempered at temperatures ranging from 1500C to 6500C and mineral oil forms a very convenient medium in which to conduct operations at lower end of this range. An oil for this purpose must not volatilise excessively or give rise to fire hazard and to obtain sufficiently low volatility it is necessary to use oil of very high viscosity grade. The maximum temperature that can be used depends on the situation. Where the oil is heated in an open pot in contact with naked flame, the flash point of the oil is an immediate criterion and it is inadvisable to exceed a temperature of about 2500C even with thickest oils available. Where the method of

heating does not involve propinquity of naked flame and the equipment is designed to minimise fire hazard temperatures exceeding 2500C may be permissible, even up to around 3000C. In such cases the flash point of the oil is not necessarily an immediate criterion of the temperature permissible, though it remains of significance as a measure of volatility.

The very high viscosity of oils suitable for tempering is not a disadvantage in practice, because the oils becomes very fluid at the working temperatures. Heat transfer, therefore, is not impaired, nor there is any undue wastage of oil by excessive 'dragout'.

The only other property of importance in a tempering oil is resistance to thickening and sludging. Both these effects may lead to uneven tempering of the parts immersed in the bath and an oil of high stability is therefore necessary.

Annealing

Annealing is the process of heating metals to soften them. Bright annealing is annealing in special atmospheres that will not oxidize the metal surface.

When metals are fabricated by cold work (cold rolling, wire drawing etc.) they often need to be annealed, either to permit further cold working or to give them certain physical properties for use. It is important especially in the case of bright annealing, that the metal should be free from contamination by substances that may burn onto and stain its surface during the annealing process. This applies particularly to the lubricants used in the cold workings. Such lubricants should therefore be formulated so as to give the least possible surface deposits.

11. Hydraulic Equipments

- Hydraulic Oils

Hydraulic Equipment

Hydraulic power transmission naturally lends itself to a wide range of purposes where multiplication of force is required, or where accurate and dependable control gear must be provided. The immense forces that may be developed by the application of hydraulic principles and precision and flexibility of hydraulic controls, could in many cases be provided only with extreme difficulty by any other means. There is therefore, an almost endless variety of hydraulic gear, but the hydraulic media employed necessarily have many features in common

The obvious prime requirements of a hydraulic medium are, that it should be relatively incompressible and sufficiently fluid to permit efficient transmission of power. These stipulations alone are met by many liquids and in fact, may have been employed more or less satisfactorily in the past. But conditions of service in modern hydraulic machinery are so precise that few liquids are able to meet their complex requirements.

Water for instance, suffers from a number of disadvantages; it promotes rusting and possesses negligible lubricating properties. Furthermore it is liable to freeze in cold weather and to boil at a temperature which is low compared with that at which oil can be used. Emulsions of soluble oil in water are sometimes used in a partially successful attempt to overcome the two disadvantages mentioned earlier, but even such emulsions are, in general, quite unsuitable for modern applications. As hydraulic media, mineral oils

are the most satisfactory products available in sufficiently large quantities and at reasonably low cost.

Where hydraulic medium with greater fire resistance than mineral oil is required, various types of synthetic and water containing fluids are available. In particular, the fire resistant emulsion fluid, a specially prepared water-in-oil type emulsion, is gaining popularity in this field. Extremely fine clearances are usual in modern hydraulic gear, and to avoid the excessive wear, the hydraulic medium must possess lubricating ability of high order. Furthermore, the designs of hydraulic systems commonly involve the lubrication of associated mechanical gear by the hydraulic fluid. A hydraulic oil must therefore perform dual function - power transmission and lubrication. This must be considered in determining the viscosity, most suitable in a hydraulic oil for a specific application. Rapid and efficient transmission of power is less readily attained with the oils of high viscosity than with those of low viscosity. Greater internal friction with oils of higher viscosity may result in considerable loss of power and increase in operating temperature. In addition, the ability of the oil to maintain fluid-film lubrication of working surface is affected by its penetrating and spreading ability. Oil of too high viscosity may fail in this respect also. On the other hand, the duties of the oil as a lubricant require that its viscosity should not be too low; moreover, an oil of too low viscosity might fail to provide an effective seal at the clearance between moving parts - for example, failure of the oil to seal pump clearances would impair the efficiency of transmission. A further requirement of hydraulic oil is that its change of viscosity over the service temperature range must not be too great. Some hydraulic systems, e.g. on machinery subjected to wide variation in ambient

temperatures and on certain machine tools, require oils with superior viscosity temperature characteristics. Correctly chosen mineral oils are entirely satisfactory in this respect.

In many hydraulic systems it is impossible to completely prevent the entry of moisture into the oil and where unsuitable oils are used, contamination with water may lead to the formation of oil and water emulsions. These emulsions vary in consistency but frequently take the form of viscous sludge which could restrict the oil flow and even lead to breakdown. Ability to separate readily from water is therefore an essential requirement for a hydraulic oil to be used in a system where water contamination is liable to occur. Adequate provisions should, of course, be made to draw off separate water from the system. Where emulsions are employed as hydraulic media, the oils from which they are made are specially produced to give the desired emulsion characteristics with a controlled amount of water. A further important consideration is that the characteristic of a hydraulic medium should remain relatively unchanged after long periods of service, so an essential requirement of hydraulic oil is stability towards oxidation. The oil is generally subjected over long periods of oxidising conditions including a combination of some or all of the following influences : high temperatures, high pressures, metallic catalysts and agitation in the presence of air. These will cause rapid breakdown of unsuitable oil, with the formation of oil soluble and insoluble degradation products. This would lead to increase in viscosity of the oil, deposition of sludge, and impairment of the oil's demulsibility and anti-foaming properties. Corrosive attack by acidic oxidation products is also a possibility.

Special hydraulic oils are now available with exceptional stability towards oxidation. They are prepared from carefully selected base oils by special refining treatment and their natural stability is improved still further by the incorporation of oxidation inhibitors.

Another requirement to be considered is that a hydraulic oil must protect the system from corrosion or rusting. That the components of the system are at all times flooded with oil is no safeguard against corrosion unless the oil itself is non-corrosive. Experience has shown that only highly refined oils of high oxidation stability remain free from corrosive acidity for long periods. However, rusting is liable to occur, irrespective of whether the oil is fresh or in a state of degradation, if the ferrous surfaces of the system are in contact with moisture and air entrained in the oil. The oil therefore, must have good metal-wetting properties and must be able to maintain a protective film over the surfaces of the system. Oils incorporating a special rust inhibitor can provide good protection against rust.

With the advent of modern hydraulic systems it has become necessary for the hydraulic fluid to have special antiwear properties. Oils have been developed having high load carrying capacity, besides having excellent thermal and oxidation stability.

A special requirement for machine tools with very slow moving tables lubricated from the hydraulic systems is that the lubricant should be able to prevent stick-slip or jerky motion on the table. This requirement can be met by the use of special additive.

12. Railroad Oils

- Diesel locomotive lubricant

Diesel Locomotives

The increasing dependence on diesel engines as one of the prime mover for rail traction has led to intensive developments in the field of diesel engine lubrication. Diesel engines operate in a more severe environment in locomotives than in most other applications. The varying duty cycles in locomotives expose the engines to various load conditions including repeated thermal cycling. They are exposed to mechanical shocks and vibrations from train forces and track irregularities.

Locomotive engines with higher loading developing greater horsepower impose high mechanical and thermal stress on various engine components including the lubricant. Hence the engine as well as the lubricant have to withstand severe operating requirements viz.

- Higher temperatures
- Higher unit loading
- Corrosive acids
- Increased level of insolubles on account of higher rate of fuel burning

Some of the diesel locomotives used nowadays requires zinc free oils due to use of silver bearings in gudgeon pin area. Further, these engines require oils of high alkalinity in order to provide additional protection against corrosive wear. In addition to this, the oil must fulfill requirements of an ideal diesel engine lubricant.

Pressure lubricant, in diesel locomotives, is the standard method for lubrication of important parts wherein oil is drawn from an oil sump by a gear pump; it is then pumped through a filter and oil cooler to the header and separate lines to main bearings. From the main bearings most of the oil passes through drilled passages in the shaft and crankwebs to the crankpin bearings. The oil then flows through drilled passages in connecting rod to piston pin bearings.

In some low speed engines force feed lubrication is effectively used.

13. Rust Prevention

- Rust Preventives

Atmospheric corrosion of metal surfaces is the case of endless expenditure and demands effective protective measures. An important part of this problem is the temporary protection which is needed for engineering and commercial products during storage or transit or while they are otherwise not in use. This includes a wide variety of finished articles, fittings, components, parts and engineering equipments generally, for which the period of protection required may range from less than a week to a year or more.

Petroleum Based Protectives

Metal surfaces can be protected against corrosion by preventing moist air from coming into contact with them. A convenient and effective way of doing this is to apply an impervious coating. For temporary protection of this kind, it is important that the protectives should be easy to apply and easy to remove when protection is no longer needed. Removal sometimes may be unnecessary and when this is so, the nature of the film must be such that it will not be objectionable when the article is in use or during subsequent manufacturing operations.

The varied nature of the work for which this kind of protection is required demands a full range of products so as to provide for the individual needs of each particular job. Modern petroleum based protectives meet these requirements in full.

We market a variety of grades specially designed to fulfill the requirements of a wide range of applications and storage conditions. The coatings they provide vary from thin, oily films, which are suitable for short periods to thicker hard films for more durable protection.

14. Turbines

Steam Turbines

Small horizontal turbines are commonly fitted with ring oiled bearings and some small machines are fitted with sight-feed lubricators, but all large sets and many small units are equipped with pressure circulating systems.

Satisfactory turbine circulating oil must not only provide adequate and dependable lubrication, it must also serve as a coolant and protect against rust, the turbine parts with which it comes into contact. Very often it is the hydraulic medium in governors and other control gears. Also, the reduction gears of geared turbine is generally lubricated from the same system, although separate lubrication is provided in some cases.

The deteriorating influences which a turbine oil has to withstand are well known. Air and moisture are inevitably present in the lubrication system and intimate mixing of the oil with air and water vapour occurs in bearing housings, gear cases and other parts of the systems. At operating temperatures this subjects the oil to oxidising conditions which may lead to the formation of the acids, sludge and permanent emulsions. Moreover, the oil is constantly in contact with catalysts such as copper, iron oxides and brass. Even in small quantities, such substance can greatly increase the rate at which oil oxidation takes place. These conditions may be aggravated by other factors such as local overheating or by contamination of the oil.

With the development through years, turbines are becoming

increasingly compact in design. The use of steam at higher pressures and temperatures have resulted in demands on the lubricant becoming progressively more severe. Under modern conditions, oils which have not been specially prepared are found to deteriorate rapidly and in some cases necessitate an emergency shutdown; overhaul of the system; and a change of oil.

These conditions and demands have been met by the development of special turbine oils whose high stability, ready separation from water, and rust-resisting properties have been proved over long periods of service. However even the best oil is not invulnerable and it is worth considering some of the factors which may have great effect on the life of a charge of oil.

Some Factors Promoting Oil Deterioration

Inefficient Coolers

Coolers may become inefficient either through sludge deposits or through scale or dirt coating the waterside of the cooling surfaces. This will give rise to general increase in the temperature of the oil and thereby hasten oxidation.

Impurities in the System

Foreign matter in the system is obviously objectionable, because it may interfere with the circulation of oil or cause mechanical trouble. Even in very small quantity it will tend, depending on its nature, to promote wear and sludging or to impair the ability of the oil to separate from water. Thus abrasive particles such as grit and rust may cause bearing wear. Metallic particles and metallic compounds

(especially rust) will increase the rate of oxidation of the oil by catalytic action, reducing its life in service. Solid particles may cause irregular behavior of the governor.

Adventitious substances such as core sand, scale, cotton waste or rust, also grease and other protective materials, are often present in the lubricating systems of the newly erected turbines. All these contaminants must be removed by a thorough and carefully conducted cleaning and flushing process before the system is filled with the initial charge of the oil. Dust, dirt and gritty particles are liable to find their way into the system & great care should be taken to exclude such matter. Breathers should embody suitable protection against the entry of contaminants, provision being made that condensate does not drain back into the system.

During service the oil should be kept clean by the removal of water and other impurities. Oil samples should be drawn off periodically and tested to check whether the purifying equipment is functioning correctly, also to assess the condition of the oil. Line filtration, in conjunction with continuous by-pass centrifuging, is probably the most efficient method of purification, although batch purification is frequently employed. Clay filtering or the use of filter elements impregnated with chemicals, may harm the oil and should be avoided.

Insufficient Ventilation

Oxidation of mineral oil is accompanied by formation of petroleum acids. Some of these acids are volatile and promote corrosion, particularly above the oil level. It is therefore necessary to provide

for their escape by adequate ventilation. If this is not done, corrosion may occur in their spaces above the oil for instance, in bearing housings, gear cases and oil reservoirs. The products of corrosion will ultimately find their way in and cause deterioration of the oil and may lead to mechanical trouble.

Mechanical Defects

The performance of the oils and its life in service can be greatly influenced by the mechanical condition of the turbine. For example, air leaks on the suction side of the pump may cause foaming. This will not only interfere with lubrication generally, but will expose a large surface of oil to heated air. Ineffective sealing of glands may allow the entry of water & steam into the bearing housings.

Incorrect Arrangement Of Oil Pipes

Oil pipes have sometimes been laid very close to hot parts of the turbine (an example is the clipping of governor oil return pipes to the turbine casing) thereby unnecessarily exposing the oil to severe heat. The end of the oil return pipe has in some cases been arranged well above the level of the oil, causing aeration as the oil pours into the reservoir. Again, pipes of inadequate size have restricted the return of oil from the bearings and gears and prevented rapid release of air.

Water Turbines

Lubrication requirements of water turbine bearings are not particularly complex.

Ordinary pedestal bearings, ring oiled or lubricated by force-feed, are employed in horizontal water turbines. In vertical water turbines the neck and thrust bearings are bath-lubricated by a circulating system. Thrust bearings are usually of the Michell type.

Difficulties may arise with water turbines having gas-loaded accumulators through irregular operation of oil actuated control gear. Oil has a greater solubility for air at high pressure than at low pressure; this air tends to go into the solution on the high pressure side and to be released, or partly so on the low pressure side of such system. If the rate of absorption of air exceeds the rate of release, the air content of the oil may rise to such a level that large quantities are suddenly liberated from solution, causing loud noise and irregular operation of control gear. This can be avoided if the system is so arranged that there is an adequate rate of air release on the low pressure side, so as to minimize entrainment of air in the oil circulated in the system.

Gas Turbines

Industrial gas turbines are of two main types. The heavy-duty type based on the steam turbine principle; and the air craft derived type, in which a modified aircraft jet engine is used as a gas generator with an additional power turbine.

The heavy duty type uses plain sleeve journal bearings and tilting pad thrust bearings for turbine and compressor as in conventional steam turbines. Their lubrication requirements can be met using steam turbine type oils. The oil is also used in hydraulic governors.

The aircraft derived gas turbines consist of two basic units - the gas generator and the power turbine. The power turbine normally has plain bearings and may be lubricated by mineral turbine oils. The gas generator is essentially a slightly modified aircraft jet engine, using ball and cylindrical bearings. The general recommendation is synthetic lubricants.

15. DG Power Generating Sets

- Oils for DG Sets running on HSD
- Oils for DG Sets running on CNG / Natural Gas
- Oils for DG Sets running on LDO / Heavy Fuels
- Oils for Cylinder Lubrication of Two Stroke Marine Engines

Diesel power plants

The diesel engine has filled an important need as a prime mover for power generation. It has enabled small power plants to be set up at locations far away from major grids.

Operation and maintenance

The diesel engine is connected to a generator which produces power when turned. The diesel engine, like any other internal combustion engine used in automobiles, requires good operating and maintenance practices.

The following four systems must function at maximum efficiency:

- Air
- Fuel
- Cooling
- Lubrication

Air

Sufficient clean air must be provided to the engine to have combustion with fuel. Adequate sized filters are required for the system. Dg sets working near highly polluted industries like cement

plants, mines etc. Are exposed to dusts which may cause rapid wear of cylinder liners and other moving parts.

Turbo charged engines especially require clean air in order to avoid turbine blade fouling.

Fuel system

DG sets may operate on a wide variety of fuels, ranging from light fuel like HSD to heavy residual fuel like LSHS. Proper fuel systems including pumps, heaters and fine filters are incorporated into the system to inject fuel through close tolerance injectors. Many contaminants are likely to harm the system and must be carefully removed. Water, solids and other debris are likely to find their way into storage tanks.

Cooling system

Cooling system removes the heat of combustion through cooling water/air / engine oil and subsequently dissipated through radiators or intercoolers. Cooling system must be fed with clean treated water in order to avoid corrosion, deposits on the heat transfer surfaces etc.

Lubrication system

The principal functions of the engine oil are to lubricate, cool and keep moving parts of the engine clean. The oil must be clean of any solid contaminants since it has to move through close tolerances. Filters and centrifuges are part of the lubrication system to take care of contamination.

Common contaminants are

- Abrasive airborne dust,
- Fuel soot from combustion,
- Carbon deposits from partially burnt oil,
- Acidic material from combustion chamber.

Selection of engine lubricant

Newer types of engine oils developed recently make it possible for power plants to work with lower grade fuel without fear of engine deposits, liner wear and port plugging.

The new lubricants can be classified as 'high alkaline type' heavy-duty oils, which in addition to usual qualities of lubricity, detergency and dispersancy, incorporate a high degree of alkalinity. This characteristic enables them to react with and neutralise acidic fuel decomposition products and greatly reduce engine wear, lacquer formation and engine deposits.

16. Greases

- Grease Lubrication
- High Temperature Grease Lubrication
- Greases with Solid Dry Lubricants

Bearing

The field of application of lubricating grease is related to their non-Newtonian characteristics. It is usual to employ grease as a lubricant where temperatures and speeds are not excessive and the sealing arrangements do not offer satisfactory lubrication by oils. In addition to being a lubricant, grease possesses excellent self-sealing properties and protects the bearing against the entry of contaminants, where the neck sealing is inadequate or elementary. The viscosity of grease at low or moderate rates of shear remains much higher than lubricating oil in general and so the bearing reaches hydrodynamic or full-film stage more rapidly than with oil.

However at high speeds frictional losses are relatively high and more frictional heat is also generated. Since the effectiveness of grease as a coolant is limited, grease lubrication of plain bearings is therefore confined to units of low or moderate speed often under 200 rpm and rarely over 300 rpm; with journal surface speeds generally 1 to 2 m/s. This speed limit is however for large bearings of 50-cm. dia. or more. With reduction in size of the bearing the maximum journal surface speed upto which losses and heating are tolerable, fall sharply.

Calcium soap greases are mainly used where temperatures are moderate. Calcium-based greases are preferable for bearings that

have to run in the presence of excessive moisture. Other types of greases are required where higher working temperatures and more satisfactory sealing properties are required than the conventional 'cup' greases. Such grades include lithium soap and inorganic-base greases and some soda soap greases, but it should be noted that Sodium soap greases are not recommended where the bearing is subjected to excessive washing by water.

Where loading is exceptionally severe for example, in roller-bearing assemblies fitted to the roll necks of a metal rolling mill, it may be necessary to use a grease with extreme pressure properties. Such greases are designed to give effective lubrication under conditions of shock loads and constant high loading. In certain applications they also require resistance to moisture; on a metal-rolling mill, for example, water is frequently used to cool the roll faces.

Whatever type of grease is used, it should have no tendency to separate under the operating conditions. When separation occurs, the oil runs out of the bearing and leaves behind dry soap that hardens and cakes. This interferes with the movement of the rolling elements; overheating and mechanical failure may result. Excessive softening is also undesirable, because the grease might leak out of the bearing and leave the working surfaces unprotected.

The methods used to apply grease are governed by the design of the bearings and by conditions of operation. They are:

- Grease Packing - Applicable where periodic addition of fresh grease is not required.

- Compression Cup or Pressure Gun Application - Employed where the addition of fresh grease is periodically necessary.
- Centralized Pressure Systems - For severe service where the rate of consumption makes it necessary to add fresh grease at frequent and regular intervals (e.g. roller-bearing assemblies of roll necks of metal-rolling mills).

In selecting lubricants for ball and roller bearings, the needs of each application must be studied. Due regard must be paid to the type of bearing, method of lubrication and operating conditions. Thereafter, to ensure satisfactory operation in service, the main points to bear in mind are the exclusion of moisture, dust and other contaminants and regular replenishment or renewal of the lubricant. Care should be taken to avoid over-filling because this may cause operating troubles; for example, a bearing that has been tightly packed with grease is liable to overheat.

Open Gears & Other application

Greases are used in large open gears in Industries. Greases are manually applied on the open gear tooth's or in special application like Cement Mill girth gears, it is sprayed on the gear tooth by a pneumatic centralised spray system. Greases also used for lubrication of rail flanges.

6. LANDMARKS :

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3.6 Indian Oil Corporation Ltd

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6. MARKETING ACTIVITIES

3.7 Bharat Petroleum Corporation Ltd

Rural Marketing:-

In order to reach distant rural customers Bharat Petroleum have introduced the Rural Marketing Vehicle (RMV) way back in 1999 in the State of Punjab. This vehicle moves from village to village and fills cylinders on the spot for the rural customers. Encouraged by success of this novel method of reaching the rural customer, BPC have introduced 24 such vehicles covering rural customers in the States of:-

- Punjab
- Tamil Nadu
- Maharashtra
- West Bengal
- Karnataka
- Gujarat
- Madhya Pradesh
- Chattisgarh
- Rajasthan
- Uttar Pradesh

Introduction of 5 Kg Cylinders

Having saturated the Urban market, the need of the hour was to get into marketing of LPG in the rural areas.

Keeping in mind the low-income group at the rural areas, it was felt that, to penetrate the rural market there was a need to introduce a smaller size cylinder so as to reduce both the initial deposit cost as well as the recurring refill cost. The deposit rate for a 5 kg. cylinder is Rs. 350/- (against Rs. 850/- for a 14.2 kg cylinder).

The option of filling 5 kg. cylinders was also available through the Rural Marketing Vehicle (RMV).

This was also an ideal option for Hilly markets. The terrain in hilly areas being difficult, it would be easier to carry these smaller size cylinders. BPCL have commenced sale of 5 kg. cylinders through the Rural Marketing Vehicles as well as through regular distributorships across the country.

3.8 Hindustan Petroleum Corporation Ltd

Since mid-2002, Hindustan Petroleum Corporation Limited (HPCL) has been providing its discerning customers with a range of new exciting, value added services designed to create a purposeful relationship with them. The launch of HP GAS as a brand was the beginning of a new chapter in the LPG (Liquefied Petroleum Gas) trade in the Indian petroleum industry. HPCL wanted to obtain an advantage in the market, post deregulation; and strive to make the proposition ever exciting and refreshing.

Differentiation strategy:

As part of HPCL's strategic marketing initiative that sought to break out of traditional LPG business, the company attempted to establish 'HP GAS' as a distinct and unique LPG brand across the country. The company has endeavoured to increase consumer focus; penetrate untapped rural markets - all the efforts being consolidated towards building a stronger brand image. Partnering the company was India's premier advertising agency JWT India.

The branding concept for HP GAS was developed after an exhaustive research that encompassed collating feedback from various external research and focus group discussions in key markets across the country.

To understand consumer needs on a continuous basis, a consumer satisfaction research was undertaken which enabled the company to launch its latest offerings. The research covered 494 distributors spread across 21 states covering a sample size of more than 15,000.

An extraordinary amount of effort went into creation of this new brand keeping in mind the needs of the users as well as non users and the customer preferences before finalising the offering.

The newly created distinct set of value added offerings range from services tailor made for consumer convenience - delivery of refills within 24 hours; extended delivery timings - 8 am to 8 pm all seven days a week; efficient and expert services - installation of a new connection within 24 hours; and single point contact for refill booking, customer service inquiries and emergency services; four-digit single number 1716 across the country for safety and convenience of HP GAS' valued consumers.

The entire communication was launched with a specially designed pneumatic of an 'animated' cylinder proclaiming 'Ji Haan' reinforcing a strong positive service orientation.

The phased roll out of 'Ji Haan' initially covered 258 distributorships in the cities of Mumbai, Delhi, Kolkata, Bangalore, Hyderabad and Pune. The new initiative 'Ji Haan' consumer campaign was extended to 690 markets covering 17 states.

HPCL is one of the first oil companies to computerise the entire distributor network to provide value added services to consumers such as refill booking through IVRS, Internet amongst others. Special training module termed as "Millennium Distributor" has been rolled out and more than 1,000 distributors covered for re-

orientation of their mindset to meet challenges of competitive scenario.

As far as HPCL is concerned, "safety" comes first. The HP Suraksha LPG hose was launched as an example of the company's commitment to safety.

As the urban domestic market is fast nearing saturation, HPCL has started focussing on rural markets - which the company's team feels would be the engines for future growth. HPCL is operating two skid mounted filling plants exclusively for rural areas and has introduced the 5 Kg cylinders. It has also played a leading role in providing LPG connections under Deepam scheme in the state of Andhra Pradesh.

HPCL is equally concerned about protecting the environment and the campaign communicated these aspects. The company embarked on an ambitious plan of creating infrastructure for dispensing LPG as auto fuel. It is in the process of setting up 30 more stations within this financial year. HPCL is also facilitating conversion of the vehicles at its outlets in Mumbai through an approved agency.

HP GAS customer services:

In July 2003, HP Gas launched the HP Home Perk programme - first ever loyalty programme for LPG consumers in the country; enhanced medical insurance upto Rs 15 lakh (Rs 1.5 million); and empowered customers across the country by giving them the option of weighing the cylinder at their door steps. These services

will enable more than 18 million customers serviced through a network of 1,900 distributors to enjoy a hassle free experience.

“The new value added services are tremendously beneficial and are among the many initiatives that we have lined up for our customers,” said HPCL marketing director NK Puri adding, “Our consumer research has shown that customers have vital concerns such as the correct weight of cylinders and safety which precedes amongst other key findings which are becoming predominantly significant. Through these new consumer initiatives and our enduring customer friendly approach, we endeavour to raise the level of service we offer our consumers.”

Weight campaign – 15,000 HP GAS delivery boys across the country carry portable weighing scales (both electronic and mechanical), which gives the customer the option of cross checking the weight of the gas at their door step. Research has highlighted the fact that almost one third of the customers are apprehensive of the weight of gas in the cylinders and this initiative will reassure consumers of the exact weight of HP gas cylinders, thus empowering customers and ensuring they receive what they are entitled too.

This promise was demonstrated by a TV commercial (TVC) which drew parallels with the commonly faced problem - Indian housewives being duped by inaccurate weighing machines used by unscrupulous *raddiwallas* (paper merchants and newsprint traders collecting old newspapers and magazines from Indian households). The TVC shows a housewife (played by TV artiste

Gautami of Zee TV's *Lipstick* fame) and her maid (TV and film actress Divya Dutta) outsmart two wily raddiwallas who con them with the help of a HP GAS delivery boy carrying accurate portable weights.

Loyalty programme – A customer can call the HP help line '1716' and become a member of 'HP Home Perks' loyalty programme without any membership fee. Through this programme, members can purchase a range of household goods at attractive discounts ranging from 40 to 50 per cent at the HP Home Bazaar and accumulate loyalty points redeemable against products.

Among various incentives offered is an opportunity to be eligible for a pyramid of prizes amounting to Rs 1 crore (Rs 10 million) through a mega draw on various regular promotions. The programme was introduced in Mumbai and will be subsequently rolled out to other cities in a phased manner.

Medical Insurance – Reinforcing its focus on customers, HP GAS has broken away from the traditional insurance policy and has come out with an enhanced umbrella insurance policy covering all consumers and third parties. This includes compensation of Rs 100,000 in case of demise; Rs 25,000 towards loss of property; and Rs 15 lakh (Rs 1.5 million) towards individual medical expenses in case of injuries due to an accident with an LPG cylinder.

HP Gas Rasoi Ghar - HP GAS has attempted to make its environment friendly fuel available to the underprivileged section, who are unable to bear the high one time deposit, and recurring cost of refills. HP GAS introduced Rasoi Ghar the concept of community kitchen. Nearly, 350 Rasoi Ghars are currently operational and benefit more than 6,500 families by providing a common cooking platform in villages, where users pay on the basis of the time utilised for cooking. This initiative is a step towards improving the quality of life in this cross section of society.

HPCL LPG Strategic Business Unit head and general manager SV Sahni says: "The HP gas customer is progressive and, conscious of their wants. To cater to these discerning customers, we are constantly trying to improvise on our services to offer a hassle free experience and our strategy fills in this need gap. All our initiatives have addressed consumer insight findings and we are confident that we will be a step ahead in delivering quality service to our customers."

After many years of an oligopolistic marketplace, the domestic LPG segment was finally opened to private players around five years back.

However, it was still not a level playing field. That's because the government LPG players like HP GAS, Bharatgas and Indane still had the advantage of government subsidies in terms of pricing. This coupled with their advantage of reach made the government LPG manufacturers the preferred choice.

Things were soon to change! With government subsidies being withdrawn, service delivery and brand image would be the key drivers for brand consideration.

Hence the need for HP GAS to take the lead in building a relevant and impactful brand position.

Communication strategy

The communication target audience straddled many different target audiences:

- * Current HP GAS users: prevent switching and use more LPG in lieu of kerosene;
- * Non-LPG users - make them positively pre-disposed towards LPG and bring HP Gas into their consideration set;
- * Rural - target rural areas where there is little/no penetration of LPG as a cooking medium; and where cheap and easily available fuels like wood and coal were easily available.

Key insight

Research conducted among housewives threw up an interesting insight.

- * The household manager performs many tasks. She receives help from other family members/hired help for most of these tasks.
- * However the cooking task is something that she handles on her own.
- * 72 per cent are responsible for cooking and cook themselves.
- * And 54 per cent don't receive any help in cooking.

Brand position

- * Given the fact that the housewife has no help in the kitchen the aim of the brand was to position itself as her "expert helper" in the kitchen.
- * A helper who provides efficient service; someone who is accessible and reliable.

Supports

This was supported by the service delivery of:

- * Immediate new gas connection;
- * Refills in 24 hours;
- * 8 am to 8 pm booking and delivery service;
- * Guarantee of right weight.

Creative execution

The position of the "expert helper" was brought alive in the brand mnemonic and the brand statement: "Ji Haan"

3.9 Indian Oil Corporation Ltd

IndianOil's Marketing Network is spread throughout the country with over 23,000 sales points (the largest in the country). These include petrol / diesel stations, consumer outlets, lube distributors, SERVO SHOPS, SKO/LDO dealers, LPG distributors, etc. The Regional offices look after the North, East, West and Southern Regions of India, and Assam Oil Division supplements operations in the NorthEast. A number of State Level, Divisional and Indane Area offices have been established in each Region.

Petroleum products are essential inputs to the industrial, transportation, commercial and household sectors.

The extensive network of sales points comprises¹²:

Unit	Number / Quantity
Divisional Offices	44
LPG Area Offices	35
State Offices	15
Terminals and Depots	165
Aviation Fuel Stations	95
LPG (Indane) Bottling Plants	87
LPG Bottling Capacity	3778 TMTA
Petrol / Diesel Stations	10144
SKO/LDO Dealers	3552
Indane Distributors	4675
SERVO Stockists	204
Bulk Consumer Outlets	5847
Towns with Indane	2064
Indane Customers	424 lakh
Markets covered by Indane	2177*
(Above figures as on 1.4.2005)	

The Marketing Mantra for Indian Oil is to continuously provide the best products and services at the most reasonable cost. The "New Look" petrol / diesel service stations selectively have "**ConveniO**" shopping stores, snap services, quick Lube change, automatic car wash and multi-product dispensing pumps. To facilitate easy transaction, many of our stations accept major credit cards. In fact, Indian Oil and **Citibank** have launched a special co-brand card, the "**Indian Oil Citibank Card**" which is

¹² Through Research

special co-brand card, the "**Indian Oil Citibank Card**" which is not only accepted at Indian Oil petrol stations but at many restaurants, shops, airlines, etc. Also, IndianOil's tie-up with **Coca-Cola** ensures that select petrol stations stock and dispense "Coke" - thus quenching the thirst of the vehicles and the motorists!

A new concept of "**Jubilee Retail Outlets**" has also been launched to set up petrol / diesel stations on highways with comprehensive value added facilities for various customer segments, namely truckers, farmers, tourists and passenger transport. These include motels, restaurants, parking lots, weighbridges, sale of tyres, batteries, accessories, agricultural machinery repairs and recreational facilities provided selectively. The first such retail outlet was commissioned at Ongole, District Prakasam, Andhra Pradesh in August 1998.

IndianOil's "**INDANE LPG**" is being marketed in as many as 2064 towns with a customer population of 349 lakh served by a network of 4120 distributors - one of the largest networks in the world.

SERVO ® lubricant range is the largest selling lubricant brand in India. IndianOil's **Aviation Service** continues to be the market leader in the aviation fuel business with a market share of nearly 67.7%. Indian Oil was the first to introduce Hydrant Refueling System in India. Indian Oil is also bunkering all types of marine fuels and lubricants required by the Shipping Industry in India.

7. RANGE OF CYLINDERS

Three types of cylinders have been manufactured by the companies:

1. Domestic LPG Cylinder
2. 19 Kg Commercial Cylinder
3. 47.5 Kg Industrial Cylinder

8. SERVICES

3.10 Bharat Petroleum Corporation Ltd :

Bharat Petroleum continuously strive to provide convenience to the customer by adapting to the most current needs and providing continued value-added service.

We welcome all our customers to avail of the various services:

- Instant Bharatgas connections for domestic and non-domestic use, i.e. Industries, Hotels, Canteens, etc.
- Pack sizes to match individual needs of customers, i.e. 14.2 kg. and 5 kg. cylinders for domestic kitchens, 19kg., 35 kg. and 47.5 kg. for Industrial / Commercial use. Besides, we also cater to customers who require Bulk LPG.
- Home Delivery of safe and sound refill cylinders within 24 hours of booking and on all 7 Days of the Week.
- 24 hr. Bharatgas cylinder booking facilities on www.ebharatgas.com and on the unique Telephone no. 1712 in select cities. Through Interactive Voice Recording System (IVRS) and Refill Booking Boxes at all other cities.
- No fault Liability and Accident Insurance Policy for all our Bharatgas customers - in case of any unforeseen circumstances.
- Customer Relations Centres all over the country to attend to suggestions and complaints of customers.

- Emergency Service Cells/Bharatgas Helplines to attend to customer leakage complaints after Distributor's working hours.
- Trained staff at Distributor's end so as to ensure courteous behaviour and safe operations.
- Assistance in designing and commissioning of LPG installation and storage facilities for Industrial & Commercial sector.
- Guidance in conversion from other fuels to LPG, e.g. Bakeries, Poultry's, Tea & Coffee drying, Brick kilns etc.
- Assistance in designing and commissioning of reticulated supply of LPG, also known as piped LPG supply in residential complexes.

Bharatgas Online Customer Service

Bharatgas Online Customer Service is a B2C (Business to Consumer) initiative launched by BPCL in order to provide a **direct** channel for Bharatgas customers to interact with BPCL. The Online Customer Service facility can be accessed through our web-site www.ebharatgas.com.

The Online Customer Service permits the Bharatgas Customer, at registration, to create his / her own Login ID and Password, which will enable him / her to interact online and access information in a secure environment and avail of the following facilities :

- Place an order for refill cylinder ONLINE
- Suggest the preferred day and / or time of refill delivery
- View Refill Order Status/Brief History
- Avail of the Reminder Service
- Participate in Contests / Promotions as and when organized on the site

Additionally, www.ebharatgas.com brings to you :

- Services offered by Bharatgas
- Answers to Frequently Asked Questions
- Information about Emergency Service Cells and Bharatgas Helplines
- Safety & Conservation tips
- Good housekeeping tips
- Health and fitness tips
- Great recipes in the Gourmet section
- Facility to send us your Feedback - "Talk to Us "

The **Online facility of booking Bharatgas cylinders** is available presently in 121 cities covering 85 lakh customers. The website is also a **B2B (Business to Business) initiative** helping our **Direct Customers, Business partners and Distributors to carry on business transactions online with us.**

Unique telephone number 1712

In our continuous endeavour to make things convenient for Bharatgas Customers, we have provided one unique telephone number 1712, which the Customer can call to order a Bharatgas cylinder or log a leakage call. This 4 digit number will be unique for BPCL all over the country.

The salient features of this facility is as under :

1. Their system will give the customer, firstly choice of language and proceed.
2. The consumer is to speak the name of the distributor and upon confirmation by the system, customer will key in the consumer number and provide refill booking number.
3. The distributor PC will call the system at fixed time intervals and down load the bookings into the software package that is in use at all the distributorships.
4. The total usage time of phone including keying in of numbers, response from System, etc is expected to be below one minute.
5. In case of leakage calls once the customer completes the call - message of customer is telephonically transmitted to the customer.

This facility is available in the nine cities of Mumbai, Delhi, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune and Jaipur

Bharatgas Help line / LPG Emergency Service cells:-

To attend to LPG leakage complaint calls after Distributor's working hours and on holidays, Emergency Service Cells (ESCs) have been set up in select markets. Please contact the nearest ESC in the event you have an emergency.

In addition to the ESCs, "**Bharatgas Helplines**" provide 24-hour service for emergency LPG leakage calls in select cities.

To locate our Emergency Service Cells / BPCL HelpLine, please visit our Find Us section of the web site.

Customer Relationship Center:-

The Customer Relations Centre under each of the Territory Offices, are situated in convenient locations for customers to visit. These centres provide customers with information regarding all policies and procedures pertaining to matters like:

- LPG distributor selection.
- Details of LPG distributors in various markets under the Territory
- Procedure for availing gas connection
- Name Changes
- Status on release of new connections/DBCS
- Transfer of LPG connections.

Necessary forms are also provided to customers visiting Customer Relation Centres to facilitate them in meeting their requests. In addition, CRCs also receive suggestions and complaints from various consumers and act upon them by tracking, resolving and informing the customers. Some of the complaints are also redressed on the spot.

They also provide any general information about BPCL and guide the customers to obtain requisite information/assistance. The CRC telephone numbers are displayed at all LPG showrooms, to enable the customers to contact them. Some of the CRCs are being provided with toll-free line to receive calls from customers free of cost, wherever Telephone Department has provided such facility.

We have also set up Customer Service Centres outside the Territory Head quarters, in conveniently located places, for customers to approach for assistance. Some of these are operated on nominated

days when the Sales Officer visits the Centre to attend to customers requests/grievances from the distributors area of operation.

We have a total of 50 CRCs operative through out the country. In addition, the Sales Officer, has a nominated day at each of the distributorship in his area, when he is present to assist customers of the particular distributorship on various matters.

3.11 Hindustan Petroleum Corporation Ltd

THE consumers of HP Gas can now cross check the weight of the gas supplied at their doorstep, as HP Gas delivery boys will hereafter carry portable weighing scales.

The weight campaign' is a part of a range of consumer-related initiatives announced by Hindustan Petroleum Corporation Ltd (HPCL), the producers of HP Gas.

The company has launched HP Home Perks, claimed to be the first ever loyalty programme for LPG consumers in the country.

This apart, it has enhanced medical insurance coverage up to Rs 15 lakh.

It has also provided a four-digit, 24-hour, HP Gas Help Line through which customers can avail services like refill booking, emergency complaints or any other customers service queries.

According to Mr S. Babuganesan, Deputy Manager (LPG), South Zone, the company's research has revealed that almost one-third of

the customers are apprehensive of the weight of gas in the cylinders and the 'weight campaign' is aimed at reassuring them of the exact weight of HP gas cylinders.

He added that through the HP Home Perks loyalty programme, members could purchase a range of household goods at 40-50 per cent discounts at the HP Home Bazaar and accumulate loyalty points redeemable against products.

Among the various incentives offered is an opportunity to be eligible for a pyramid of prizes amounting to Rs 1 crore through a mega draw on various regular promotions. There is no membership fee.

This programme is being introduced in Mumbai and will be subsequently rolled out to other cities in a phased manner.

The enhanced medical insurance policy includes compensation of Rs 1 lakh in case of demise, Rs 25,000 towards loss of property and Rs 15 lakh towards individual medical expenses in case of injuries due to accident caused by an LPG cylinder.

Under HP Help Line, the information once keyed in or spoken by the customer is stored in the master database. Afterwards, when the customer calls from the same number, they would be immediately recognised without need for any further inputs.

Mr Babuganesan said that the new initiatives were part of the 'Ji Haan' consumer campaign that was launched a year back across six metros and extended to 690 markets covering 17 States.

The campaign improved HP Gas brand recall from 17th position to 4th position and gained a strong association with reliability and quick service.

In order to understand consumer needs on a continuous basis, HPCL had undertaken a consumer satisfaction research that enabled it to launch its latest offerings.

The research covered 494 distributors spread across 21 States comprising a sample size of more than 15,000.

The company also rolled out a special training module and more than 1,900 distributors were being re-oriented to bring about a change in their approach to meet challenges in a competitive scenario.

Other initiatives undertaken included new dealer signage at 1,200 distributors and face-lift for all bulk LPG tank trucks, packed trucks and distributor vehicles.

3.12 Indian Oil Corporation Ltd

Indian Oil is ready to offer the world a host of techno-participation and consultancy capability and share this expertise with other oil companies in the world, through Strategic Alliances and Joint Ventures in the areas of Refining, Pipeline, Transportation, Marketing, R&D and Training/Consultancy.

Major plans are under execution to augment infrastructure and expand into exploration & production of crude oil, petrochemicals,

power generation and LNG. The company is also globalising its R&D activities, training and Consultancy services, and marketing of products, including lubricants.

Indian Oil's capabilities in the downstream sector of operations in the oil sector include:

- ❑ Technical Services
- ❑ Operation and Maintenance
- ❑ Techno-economic Feasibility / Special Studies
- ❑ Turnaround Maintenance - Planning, Monitoring & Execution
Inspection
- ❑ Quality Control: Bench-marking
- ❑ Shipping and Commercial
- ❑ Research and Development
- ❑ Safety and Industrial Hygiene
- ❑ Quality Auditing / Management
- ❑ Materials Management
- ❑ Training

9. FUTURE PLANS

9.1 Bharat Petroleum Corporation Ltd

Research & Development (R&D)

Specific areas in which R&D is being carried out by the Company

- Catalytic processes
 - Clean Fuel Technology
 - Residue Upgradation
 - Detailed crude evaluations
 - Value added products
 - Modelling and simulation of Refinery processes
 - Corrosion and fouling
 - Analytical methods development
 - Alternate fuels
 - Product and application development
-
- High performance Diesel Engine Oil
 - Synthetic Gear Oil
 - Rust Preventive for cold rolled sheets for Steel Plants
 - High performance Greases
 - Metal Working Fluid
 - Exclusive grades for Defence
 - Radiator Coolant
 - Alternate formulations for existing grades

Future Plan of Action

- Intensifying and enlargement of activities in the area of Refinery processes and residue up-gradation.
- Development of new processes for clean fuels
- Enlargement of crude basket
- Value added products/solvents from the Refinery streams
- Bio-technological processes
- Alternate Fuels e.g. Bio-diesel and Hydrogen
- Undertaking collaborated research programmes with other R&D institutions, universities, etc.
- Developing the following grades / products:
 - High performance Gasoline Engine Oil
 - Long life Rear Axle Oils
 - Synthetic Gear Oils for Industrial gears
 - Metal Working Fluid
 - High performance Greases
 - Exclusive grades for Defence
 - Alternate formulations for existing grades

9.2 Hindustan Petroleum Corporation Ltd

A NEW INITIATIVE CONCEPT OF “ HP GAS RASOI GHAR ”

HP GAS ‘RASOI GHAR’ is an unique project wherein LPG installation for the purpose of cooking is set up by HPCL in villages, Hospitals and Ashrams where the space for setting up kitchen is provided by local govt., panchayats and self help groups etc.

Based on the requirements and number of users, installation along with adequate number of cylinders and stoves are provided for safe handling and cooking purpose by HPCL. In some locations, utensils, pressure cookers etc., are also provided by HPCL.

All these 'Rasoi Ghars' are managed by panchayat committees or self help groups. Safety clinics/training are conducted by HPCL before commencement of 'Rasoi Ghars' for safe handling of equipments by the users/villagers. Consumers utilising these facilities are charged based on consumption of gas.

LPG being eco- friendly and clean fuel, HPCL will be taking steps to promote 'Rasoi Ghars' across the country for improved health and environment . In Hospitals and Ashrams, floating population find it convenient to use 'Rasoi Ghar' facility.

Current Scenario

Rasoi Ghar(over 500 Nos) introduced in 21 states More than 9200 families are using this facility HPCL plans to spread the concept of Rasoi Ghar across the country in the near future.

HPCL also commissioned Rasoi Ghars in hospitals, truck parking areas, dharmasalas , old age homes & ashrams across the country.

Exploring the possibilities for introducing burners with higher efficiency for reduction of fuel cost

Exploring the possibilities of associating with NGOs , self help groups in propagating the concept of Rasoi Ghars in big way.

More and more villages are discovering the benefits of HP GAS Rasoi Ghar and LPG

Here's how HP GAS Rasoi Ghar can benefit you:

The time presently spent by people in searching for or buying firewood can be used more productively.

No one-time investment on deposit for cylinder & regulator, hot plate and utensils for individual customers.

No recurring cost on refills

One-point, well equipped, ready to use cooking place.

Affordable fuel price- payment based on actual duration of usage
Saving in cooking time as compared to firewood/kerosene Eco-friendly, clean fuel Conservation of forests – no unnecessary cutting of trees which provide so many necessities of life Would help to radically improve health and hygiene conditions Proper training and safety clinics conducted by our experts.

RASOI GHAR in action

Pilot project at Agwan village, Dist Thane, Maharashtra
Commissioned on August 17, 2002 Facilities provided: 6 double burners 4 single burner stoves, bank of four cylinders connected with Suraksha hoses LPG charges: Approx Rs 6 per hour Utilized by

75 families per day Average consumption: 30 cylinders per month
Today, the facility is independently run by the village panchayat, who also handle day-to-day operations including collection of money, booking refills etc.

9.3 Indian Oil Corporation Ltd :

PROJECTS UNDER IMPLEMENTATION

Mundra – Kandla Crude Oil Pipeline And Conversion Of Kandla – Panipat Section of KBPL to Crude Oil Service

The Rs 305.60 crore project consists of following three components: Utilising Single Point Mooring facilities of Gujarat Adani Port Limited (GAPL) and associated offshore and onshore pipeline for handling additional crude oil for Panipat Refinery expansion and taking to Mundra crude oil terminal.

Construction of tank farm consisting of eight crude oil storage tanks of 60,000 kl each (total: 4,80,000 kl) at Mundra and laying 73 km 28 inch diameter pipeline from Mundra to scrapper station at Churwa (near Gandhidham).

Hook up of mainline with Kandla – Bhatinda Pipeline (KBPL) and conversion of Kandla -Panipat section to crude oil service.

Branch Pipeline to Chittaurgarh from Sidhpur – Sanganer Product Pipeline

The Project consists of laying a 12-inch diameter 160 km long pipeline from Lasariya on Sidhpur – Sanganer Product pipeline to

Chittaurgarh and construction of depot facilities at Chittaurgarh. Pipeline will establish cost effective product placement at Chittaurgarh marketing depot, which is constructed as a resitment of old Kota and Udaipur depots.

Koyali – Dahej Product Pipeline

The Project consists of laying 14-inch diameter, 112 km long product pipeline from Koyali to proposed Dahej terminal. Approved cost of the project is Rs 90.50 crore. The pipeline will provide for an assured means of evacuation of surplus products from land-locked Koyali refinery for further coastal movement and export.

Paradip - Haldia Crude Oil Pipeline

The project consists of installation of crude oil handling facilities at Paradip Port including laying 48 inch diameter, 20 km transfer pipeline, development of tank farm at Paradip consisting of 15 crude oil storage tanks of 60,000 kl each (Total: 9,00,000 kl) and laying 30 inch diameter, 330 km long crude oil pipeline to Haldia-Barauni Crude Oil Pipeline (HBCPL) Haldia. The pipeline will facilitate transportation of crude oil to Haldia and Barauni refineries in an efficient and cost effective manner compared to the present system of receipt of crude oil through the Haldia Dock Complex. Approved cost of the pipeline is Rs 1178 crore.

Augmentation of Bongaigaon - Siliguri Section of GSPL

Augmentation of Bongaigaon-Siliguri section of Guwahati-Siliguri Pipeline (GSPL) to 1.4 MMTA capacity has been approved in Sept. 2004 at a cost of Rs 28.61 crore.

Koyali – Ratlam Product Pipeline

Project consists of laying 16-inch diameter 274 km long product pipeline from Koyali refinery to Ratlam, where a new terminal is to be constructed on resitment basis. Project has been approved at a cost of Rs 322.92 crore (Pipeline: Rs 224.69 crore; Terminal: Rs 96.21 crore; Refinery facilities: Rs 2.02 crore). The pipeline will facilitate effective evacuation of products from Koyali refinery and ensure cost-effective and reliable transportation of products to Central India and northwest UP thereby strengthening IndianOil's product positioning capability.

Construction of Additional Crude Oil Tanks at Mundra

Construction of four additional crude oil storage tanks at Mundra has been approved in June 2004 at a cost of Rs 70.57 crore as part of crude oil blending facilities. Tank construction works are in progress.

Construction of Terminals and Tap-Off-Points (TOP) Facilities

Pipelines Division is constructing terminals at Trichy, Sankari, Chittaurgarh, Jasidih and Ratlam, linked to various pipelines. TOPs costing around Rs 215 crore will have around 1.75-lakh kl of product storage capacity.

An 18-inch diameter 8 km long piggable product dockline from IBP, Narimanam terminal to Chennai Petroleum Corporation Ltd. (CPCL) jetty at Nagappattinam is also under construction at a cost of Rs 22 crore.

Dadri-Panipat R-LNG Spur Pipeline

Indian Oil is planning to construct 132 km long 30 inch diameter R-LNG spurline from GAIL's Dadri terminal in UP to Panipat. The proposed R-LNG pipeline would provide for an economical means of feeding natural gas to Panipat refinery. The estimated cost of the pipeline system is Rs.250.66 crore at April 2005 price level. The project is scheduled to be completed by December 2006 matching with the commissioning of Panipat Naphtha Cracker Project.

Raxaul-Amlekhganj Pipeline

Indian Oil supplies bulk petroleum products like MS, SKO and HSD to Nepal through Nepal Oil Corporation (NOC). The requirement of petroleum products in Amlekhganj (Nepal) is met from IndianOil's Raxaul depot by transporting by road. A project of laying a pipeline between the depots at Raxaul and Amlekhganj facilitating uninterrupted and cost-effective supply of products at Amlekhganj is under examination of IndianOil. The project to be implemented at an estimated cost of Rs. 40 crore.

Chennai-Bangalore Pipeline

In order to meet the demand of Bangalore-fed areas and effective product evacuation from Chennai Petroleum Corporation Ltd (Chennai), Indian Oil will be laying a petroleum product pipeline from Chennai to Bangalore. The proposed pipeline would ensure uninterrupted supply of petroleum products to Bangalore-fed areas in a cost-effective manner. Indian Oil Board has accorded the first stage approval for this project to be implemented at an estimated cost of Rs. 204.14 crore.

Branch Pipeline to Delhi from Panipat-Rewari Pipeline

A pipeline from Panipat-Rewari Pipeline to Delhi is under conceptual stage, which envisages laying of a branch pipeline from a suitable tap-off point on Panipat-Rewari Pipeline up to the proposed marketing terminal at Tikrikalan near Delhi. By providing connectivity to the proposed Tikrikalan depot from Panipat-Rewari Pipeline, Panipat refinery products can be positioned at Delhi in a cost-effective manner meet the demand of Delhi fed areas. The estimated cost of the pipeline system is about Rs. 30 crore at September 2004 price level.

Panipat-Jalandhar LPG Pipeline

First stage approval was accorded by Indian Oil Board to lay a LPG pipeline from Panipat refinery to Jalandhar for feeding LPG bottling plants at Nabha and Jalandhar in a cost-effective manner. The pipeline project at a capital cost of Rs. 155 crore is to be completed in 24 months from the date of investment approval.

Paradip-Rangali-Raipur Pipeline with Branch Pipeline to Bundu (Ranchi/Tatanagar)

Indian Oil is conceiving a pipeline project to transport the petroleum products from its proposed refinery at Paradip to the consumption centres in Orissa and Chattisgarh. The pipeline to be laid from Paradip to Raipur via Rangali with a branch pipeline to Bundu (Ranchi/Tatanagar). The proposed pipeline would ensure uninterrupted supply of petroleum products to the demand centers in a cost-effective manner. The estimated capital cost of the pipeline project is Rs. 900 crore.

CHAPTER - IV

MARKETING OF COMMERCIAL CYLINDER BY PRIVATE AND PUBLIC SECTOR COMPANIES

1. *Market Segmentation*
2. *Market Positioning*
3. *Product*
4. *Swot Analysis*
5. *Publicity and Advertising*
6. *Competition in world market and major competitors*
7. *Competitive Strategies*
8. *Production planning and control*

CHAPTER – IV

MARKETING OF COMMERCIAL CYLINDER BY PRIVATE AND PUBLIC SECTOR COMPANIES

1. Market Segmentation¹

Graph 4.1

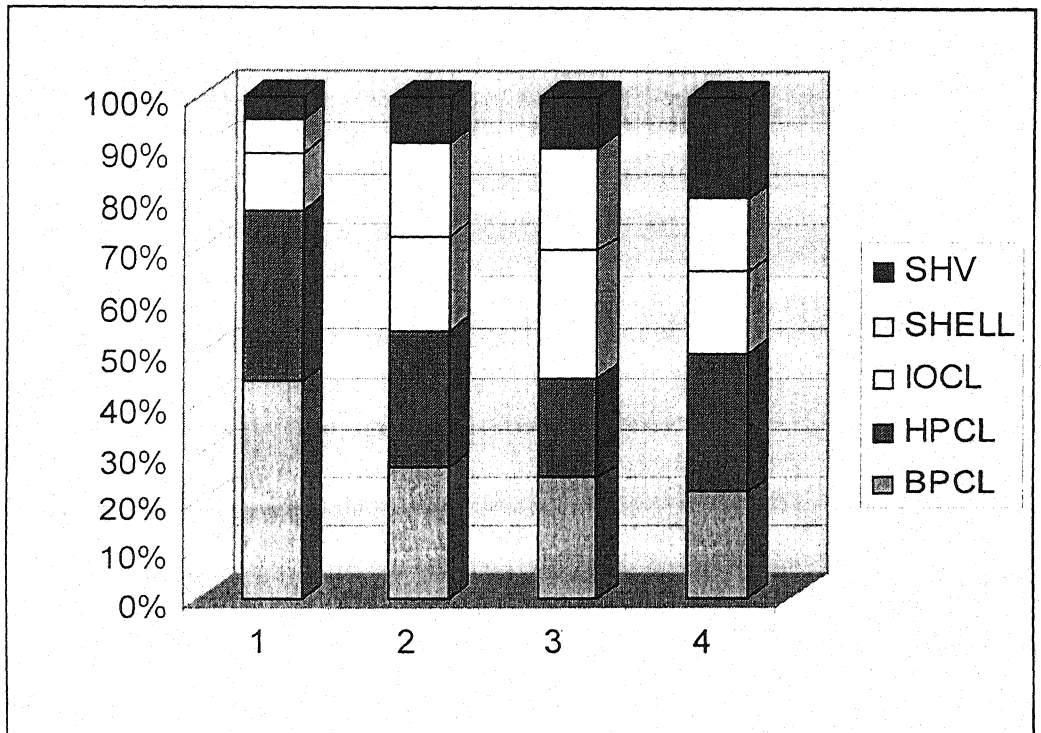


Table 4.1:

1	Hotels	76
2	Restaurants	69
3	Industry	31
4	Small Joint	24
Total		200

¹ Through Research

Therefore :

	B P C L	HPCL	IOCL	SHELL	S H V	TOTAL
HOTEL	40 %	30%	15%	10%	5 %	100%
RESTAURANT	20 %	30%	20%	20%	10 %	100%
INDUSTRY	20 %	20%	25%	20%	15 %	100%
SMALL JOINTS	15 %	25%	15%	15%	30 %	100%

2. Market Positioning

Positioning is a perceptual location. It's where your product or service fits into the marketplace. Effective positioning puts you first in line in the minds of potential customers.

As individuals, we continually position ourselves. The responsible older sibling, the class clown, a number cruncher, a super genius are all examples of positioning. These identifiers help us define ourselves and distinguish our abilities as unique and different from other people.

Positioning is a powerful tool that allows you to create an image. And image is the outward representation of being who you want to be, doing what you want to do, and having what you want to have.

Positioning yourself can lead to personal fulfillment. Being positioned by someone else restricts your choices and limits your opportunities.

That's why it's so important for entrepreneurs to transform their passion into a market position. If *you* don't define your product or service, a competitor will do it for you. Your position in the market place evolves from the defining characteristics of your product. The primary elements of positioning are:

Pricing. Is your product a luxury item, somewhere in the middle, or cheap, cheap, cheap.

Quality. Total quality is a much used and abused phrase. But is your product well produced? What controls are in place to assure consistency? Do you back your quality claim with customer-friendly guarantees, warranties, and return policies?

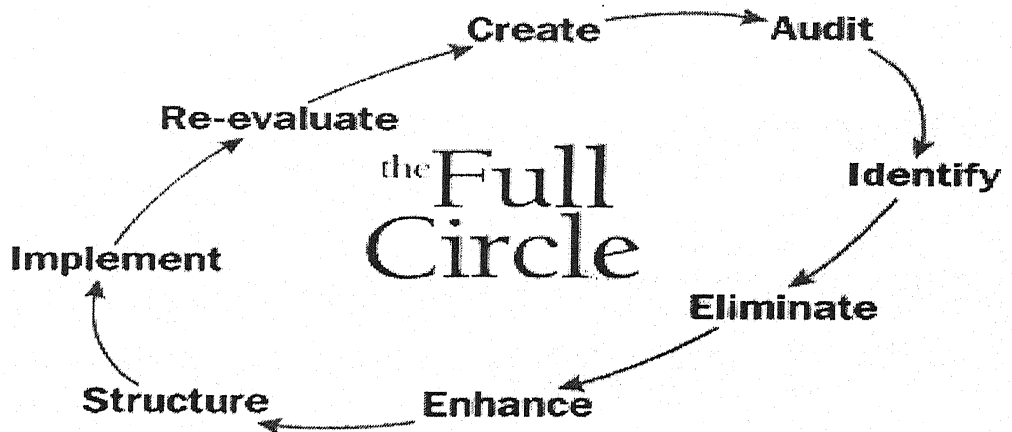
Service. Do you offer the added value of customer service and support? Is your product customized and personalized?

Distribution. How do customers obtain your product? The channel or distribution is part of positioning.

Packaging. Packaging makes a strong statement. Make sure it's delivering the message you intend.

Positioning is your competitive strategy. What's the one thing you do best? What's unique about your product or service? Identify your strongest strength and use it to position your product.

The Process



1. Audit

- Product/Service Offering
- Market Positioning
- Competitive Environment
- Delivery Channels
- Sales Force Efficiency
- CRM Efficiency

2. **Identify** opportunities for immediate impact allows you to add revenue immediately and continuously over the long term.
3. **Eliminate** organizational obstacles and inefficient processes.
4. **Enhance** current processes with minimal investment, enabling your corporation to increase profitability of new business development channels.
5. **Structure** a system that will create immediate impact and have the capacity to grow as the organization grows.

6. **Implement** processes that will produce consistent, measurable results in the growth of your business.
7. **Reevaluate** and create a cycle of continuous improvement and growth.
8. **Create** and sustain a competitive edge in the ever-changing marketplace by building a sound sales and marketing infrastructure.

Thus if we take the Target Market to be commercial outlets then the companies have done their positioning as below:

Companies Name	Positioning (Target Market : Commercial Outlets)
BPCL	Energizing Lives
HPCL	HP Gas providing end to end solution
IOCL	Safe, Reliable & Convenient
SHELL	Worlds Largest Marketer and Distributor of LPG.
SHV	World renowned LPG Brand

3. Product

All the companies in the market are having similar products
i.e. 14.2kg Packing , 19 Kg Packing, 45 Kg Packing.



4. Swot Analysis

Private Sector V/S Public Sector

Private Oil Companies

STRENGTHS

- Large international company
- Access to tech know how
- Aggressive Marketing support
- Strong infrastructure

WEAKNESS

- Organizational study
- Seen as private marketer
- Distribution network not dense
- Assured availability
- Bulk supply source
- No Subsidy from the government

OPPORTUNITIES

- Use of our past in India
- Use of joint venture – stability
- Develop planned dense rural market
- Provide care for customer - attitude and interactions
- Assure availability
- High quality LPG
- Speedy decisions to ensure edge
- Focused SPA
- Local quick decision
- Third party filling
- Private marketer consumers

THREATS

- Renewed focus expansion
- Use of additional capital
- Domestic cylinder supply in commercial outlet.

National Oil Corporations

STRENGTHS

- Government backed
- Subsidy available
- Critical mass available
- Perceived as stable by consumers

WEAKNESS

- Rural coverage poor
- Slow decision process
- Insensitive to customers distribution/allocation v/s marketing
- High cost structures

OPPORTUNITIES

- Develop planned dense rural network
- Provide care for customers
- Speedy decision to edge
- "Black Connection" switch

THREATS

- Aggressively looking to consolidate
- Plans to expand rural markets
- Developing filling infrastructure

5. Publicity and Advertising

Here are the Advertising and Publicity Stunts Taken by Private & Public Sector Oil Companies

1. **Newspapers.** Newspapers are one of the traditional mediums used by businesses, both big and small alike, to advertise their businesses.

Advantages

- Allows you to reach a huge number of people in a given geographic area
- You have the flexibility in deciding the ad size and placement within the newspaper
- Your ad can be as large as necessary to communicate as much of a story as you care to tell
- Exposure to your ad is not limited; readers can go back to your message again and again if so desired.
- Free help in creating and producing ad copy is usually available
- Quick turn-around helps your ad reflect the changing market conditions. The ad you decide to run today can be in your customers' hands in one to two days.

Disadvantages

- Ad space can be expensive
- Your ad has to compete against the clutter of other advertisers, including the giants ads run by supermarkets and department stores as well as the ads of your competitors
- Poor photo reproduction limits creativity
- Newspapers are a price-oriented medium; most ads are for sales
- Expect your ad to have a short shelf life, as newspapers are usually read once and then discarded.
- You may be paying to send your message to a lot of people who will probably never be in the market to buy from you.
- Newspapers are a highly visible medium, so your competitors can quickly react to your prices
- With the increasing popularity of the Internet, newspapers face declining readership and market penetration. A growing number of readers now skip the print version of the newspaper (and hence the print ads) and instead read the online version of the publication.

2. **Magazines.** Magazines are a more focused, albeit more expensive, alternative to newspaper advertising. This medium allows you to reach highly targeted audiences.

Advantages

- Allows for better targeting of audience, as you can choose magazine publications that cater to your specific audience or whose editorial content specializes in topics of interest to your audience.
- High reader involvement means that more attention will be paid to your advertisement
- Better quality paper permits better color reproduction and full-color ads
- The smaller page (generally 8 ½ by 11 inches) permits even small ads to stand out

Disadvantages

- Long lead times mean that you have to make plans weeks or months in advance
- The slower lead time heightens the risk of your ad getting overtaken by events
- There is limited flexibility in terms of ad placement and format.
- Space and ad layout costs are higher

3. **Yellow Pages.** There are several forms of Yellow Pages that you can use to promote and advertise your business. Aside from the traditional Yellow Pages supplied by phone companies, you can also check out specialized directories targeted to specific markets (e.g. Hispanic Yellow Pages, Blacks, etc.); interactive or consumer search databases; Audiotex or talking yellow pages; Internet directories containing national, local and regional listings; and other services classified as Yellow Pages..

Advantages

- Wide availability, as mostly everyone uses the Yellow Pages
- Non-intrusive
- Action-oriented, as the audience is actually looking for the ads
- Ads are reasonably inexpensive
- Responses are easily tracked and measured
- Frequency

Disadvantages

- Pages can look cluttered, and your ad can easily get lost in the clutter
- Your ad is placed together with all your competitors
- Limited creativity in the ads, given the need to follow a pre-determined format

Ads slow to reflect market changes

4. Radio

Advantages

- Radio is a universal medium enjoyed by people at one time or another during the day, at home, at work, and even in the car.
- The vast array of radio program formats offers to efficiently target your advertising dollars to narrowly defined segments of consumers most likely to respond to your offer.
- Gives your business personality through the creation of campaigns using sounds and voices
- Free creative help is often available
- Rates can generally be negotiated
- During the past ten years, radio rates have seen less inflation than those for other media

Disadvantages

- Because radio listeners are spread over many stations, you may have to advertise simultaneously on several stations to reach your target audience
- Listeners cannot go back to your ads to go over important points
- Ads are an interruption in the entertainment. Because of this, a radio ad may require multiple exposure to break through the listener's "tune-out" factor and ensure message retention

- Radio is a background medium. Most listeners are doing something else while listening, which means that your ad has to work hard to get their attention
5. **Direct Mail.** Direct mail, often called direct marketing or direct response marketing, is a marketing technique in which the seller sends marketing messages directly to the buyer. Direct mail include catalogs or other product literature with ordering opportunities; sales letters; and sales letters with brochures.

Advantages

- Your advertising message is targeted to those most likely to buy your product or service.
- Marketing message can be personalized, thus helping increase positive response.
- Your message can be as long as is necessary to fully tell your story.
- Effectiveness of response to the campaign can be easily measured.
- You have total control over the presentation of your advertising message.
- Your ad campaign is hidden from your competitors until it's too late for them to react
- Active involvement - the act of opening the mail and reading it -- can be elicited from the target market.

Disadvantages

- Some people do not like receiving offers in their mail, and throw them immediately without even opening the mail.
- Resources need to be allocated in the maintenance of lists, as the success of this kind of promotional campaign depends on the quality of your mailing list.
- Long lead times are required for creative printing and mailing
- Producing direct mail materials entail the expense of using various professionals - copywriter, artists, photographers, printers, etc.

Can be expensive, depending on your target market, quality of your list and size of the campaign.

6. **Telemarketing.** Telephone sales, or telemarketing, is an effective system for introducing a company to a prospect and setting up appointments.

Advantages

- Provides a venue where you can easily interact with the prospect, answering any questions or concerns they may have about your product or service.
- It's easy to prospect and find the right person to talk to.
- It's cost-effective compared to direct sales.
- Results are highly measurable.

- You can get a lot of information across if your script is properly structured.
- If outsourcing, set-up cost is minimal
- Increased efficiency since you can reach many more prospects by phone than you can with in-person sales calls.
- Great tool to improve relationship and maintain contact with existing customers, as well as to introduce new products to them
- Makes it easy to expand sales territory as the phone allows you to call local, national and even global prospects.

Disadvantages

- An increasing number of people have become averse to telemarketing.
- More people are using technology to screen out unwanted callers, particularly telemarketers
- Government is implementing tougher measures to curb unscrupulous telemarketers
- Lots of businesses use telemarketing.
- If hiring an outside firm to do telemarketing, there is lesser control in the process given that the people doing the calls are not your employees
- May need to hire a professional to prepare a well-crafted and effective script

- It can be extremely expensive, particularly if the telemarketing is outsourced to an outside firm
- It is most appropriate for high-ticket retail items or professional services.

7. **Specialty Advertising.** This kind of advertising entails the use of imprinted, useful, or decorative products called advertising specialties, such as key chains, computer mouse, mugs, etc. These articles are distributed for free; recipients need not purchase or make a contribution to receive these items.

Advantages

- Flexibility of use
- High selectivity factor as these items can be distributed only to the target market.
- If done well, target audience may decide to keep the items, hence promoting long retention and constant exposure
- Availability of wide range of inexpensive items that can be purchased at a low price.
- They can create instant awareness.
- They can generate goodwill in receiver
- The items can be used to supplement other promotional efforts and media (e.g. distributed during trade shows).

Disadvantages

- Targeting your market is difficult.
- This can be an inappropriate medium for some businesses.
- It is difficult to find items that are appropriate for certain businesses
- Longer lead time in developing the message and promotional product
- Possibility of saturation in some items and audiences

Wrong choice of product or poor creative may cheapen the image of advertiser

8. Television Advertising:

If you can afford television advertising, you can typically benefit in a greater manner than using any other form of media. Your ad, however, needs to be carefully written and produced to be effective. For that reason, it is often advisable to hire an advertising agency to work with you while creating a suitable television commercial campaign.

Advantages of advertising on television:

- Reach a large demographic audience.
- Lends a degree of credibility.
- You can establish a specific image more easily.
- It allows for much more creativity.
- You can establish your presence or introduce a new product very quickly.

Disadvantages of television advertising

- High production costs for a quality commercial.
- Very dependent on placement.
- Very costly to buy time in medium to large markets: make sure your budget allows for television advertising.
- Difficult and costly to make changes.

Television advertising can be very draining on your budget. The cost of producing a commercial is only a small portion of the overall expense. Buying time on local or national networks will be the bulk of your cost factor, and like radio, you need to buy in blocks and repeat a commercial many times to the same target audience to be effective. You also need to carefully study demographics and ratings for various programs and time slots before committing to television advertising.

Establishing an image and accentuating the key selling points or benefits of your product or service through your script are the keys to a successful commercial. Entertainment and creativity are important factors, provided they do not detract from the product. Many advertisements are fun to watch, but moments later viewers cannot recall what product was being advertised.

Advertising vs. Publicity

What other people say about you (publicity, referrals and testimonials) is infinitely more believable and less expensive than what you say about yourself (conventional advertising).

This is why advertising isn't enough - effective publicity is a vital part of any marketing campaign. You can leverage the power of your existing customers and the media to tremendously increase the impact of your marketing message by making it far more credible.

Let's start with the simple press release. Most companies do an absolutely terrible job with this. You can't begin to imagine the quantity of pure drivel that rolls off of editors fax machines and mail slots every day. Most press releases are poorly written, vague and pompous all at the same time.

Whether it's jingles you hear on the radio, the classified section of your newspaper or your favorite magazines, everywhere you turn you are exposed to advertising in one form or another.

Publicity is everywhere too. When celebrities lend their names to popular causes, that is publicity. When you send out a press release, you hope it will get picked up and create publicity for your business. Publicity helps build credibility by letting your potential customers see another side of your business. In its best incarnation, it informs, entertains or educates.

In short, advertising is something you create, pay for and control. Publicity is something someone else writes or says about you

when you do something noteworthy or interesting. However, you can "create" good publicity and a good marketing plan includes both.

6. Competition in world market and major competitors

Primary Energy Consumption

Primary energy is a critical input and in line with economic growth, as observed since the late seventies. The world consumption of energy increased from about 4,800 million metric ton of oil equivalent (mmtoe) in 1970 to about 8,477 mmtoe in 1999, representing a CAGR of about 1.98%. The growth in consumption would have been much higher but for the disintegration of the former Soviet Union, whose energy consumption levels dropped by more than 35% in the last five years.

TABLE 4.2 The average per capita consumption of energy vis-a-vis hydrocarbons (kgOE)²

Contry/Region	Primary Energy	Hydro-Carbons
World	1454	927
India	285	113
China	688	169
Pakistan	264	231
Bangladesh	81	80
Japan	3962	2520
U.K.	3856	2719
Germany	4102	2539

Importance of oil & gas in primary energy

Oil & Gas constitute a significant 63% of the primary energy consumption. The situation in Asia/ Australia is different with coal still remaining the primary source of energy. However, the scenario is rapidly changing, for instance in the last decade, oil & gas consumption has grown at more than 70% in the Asia-Pacific region vis-a-vis 15% in the rest of the world (excluding the former Soviet Union, where the growth rate has been negative). The Asia Pacific region is thus gaining importance in the oil & gas map, with India

² Source : *British Petroleum Statistics - 1998*

and China together accounting for 47.50% of the total demand in this region.

In the last decade, natural gas has taken the lead in growth and in the emerging energy scenario, it is seen as an environment-friendly substitute for relatively scarcer - oil. Consumption of natural gas has grown by more than 26% vis-a-vis 15% in consumption of oil.

Oil and gas reserves

As at end 1999, the world had proven oil reserves of a little over 1,055 million barrels (about 140,900 mmt) while that of gas, a little less than 140 trillion cubic meters. At the current rate of production, oil reserves are likely to last for about 40 years and natural gas reserves for about 65 years. The reserves are however unevenly distributed with the Middle East countries together holding 65% of oil and 34% of the gas reserves.

Oil - Widely traded energy source

Considering the fact that oil & gas would be available in the foreseeable future without any constraint, oil & gas would continue to be the most widely traded energy source. World oil trade is estimated to be 38 million barrels a day. The inherent advantages of oil & gas in terms of versatility ease in handling & transport and adaptability to new environmental standards would make it the most preferred fuel. Though reserves by themselves are not a cause for worry, experts feel that as the reserves/ production ratio falls, the

cost of exploration could rise with increased investment in development of resources leading to a surge in prices.

World refining capacity - Reaching record levels

As of 1999, the world's total refining capacity was close to 82,861 thousand barrels a day. The refinery throughput in the year 1999 stood at 71,126 thousand barrels a day, representing an average capacity utilization of about 85%.

Oil & gas prices

Oil and gas prices are closely linked to the policies and capacity utilization of OPEC. Thanks to the two oil price shocks, oil prices which were reasonably flat at about US\$3/ bbl till early seventies spiked to more than US\$10/ bbl in 1973-74 and again to more than US\$25/ bbl in 1979-80. The prices have thereafter hovered between US\$15-25/ bbl but for a short blip in 1990 due to Iraqi invasion Kuwait. In 1998, oil prices crashed once again to a decade low of US\$11/bbl due to excess capacity, poor off-take and an overall slowdown in world economies. Subsequently OPEC reduced crude output, which escalated prices from \$11/bbl in 1998 to \$32/bbl in June 2000. Later though OPEC increased production twice (by 1.45mbpd in September '99 and 0.7mbpd in June'00), the quantum was insufficient to tame prices. The world market now banks on increased supply from non-OPEC countries namely Mexico, Oman and Norway.

The product prices do not necessarily move in tandem with the crude oil prices but as a direct function of regional refining capacities vis-a-vis demand & supply.

Natural gas prices on the other hand have also increased from US\$1.5-2.5 per mbtu in 1998 to \$4.36 per mbtu in June 2000. Unlike crude oil, there are no benchmarks for natural gas and the price is based on calorific value of gas, local demand & supply and cost of alternate liquid fuels. Huge disparities exist in the price of natural gas not only between countries but also within a country.

Energy scenario in India

Primary energy consumption in India

Excluding the non-commercial energy sources like wood and animal waste, the primary energy consumption in India was 285kgOE in 1998 as against 5800kgOE in North America. Coal continues to be most important source of energy, constituting more than 56% of the total energy consumption though there is a conscious shift towards oil as alternate fuel. The over all demand for oil products increased from 74mtpa in 1996 to 90mtpa in 2000, representing CAGR of 5%. At current levels the estimated demand by 2005 is expected to be around 114mtpa while the refining capacity would be around 155mtpa.

Oil & gas - reserves & production

There are 26 sedimentary basins in India covering an area of 1.78 mn sq km, of which 1.46 mn sq km are onshore and 0.32 mn sq km

are offshore in water with up to 200 meters in depth. The total prognosticated reserves are estimated at 20 bbl of oil, but till date only 27% of this has been discovered. A total of 5.4 bbl of oil (about 732 mmt) has thus been discovered, with the annual production in the region accounting to 35-40 mmtpa. These reserves are likely to last for the next 20 years. However, the current production level of 35 mmtpa would be highly inadequate, especially once the planned refining capacities come on stream a large portion of the crude would need to be imported.

As of 1995, the proved gas reserves were about 660 billion cubic meters (bcm) while production as of 1999 was 27bcm. At current production levels these reserves are likely to last for about 30 years.

TABLE 4.3 Natural Gas Demand (MMSCMD)³

Year	Demand
1999-2000	110
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Refining Capacities

The refining capacity increased from 69.14mtpa in FY99 to 109mtpa as of January 2000 i.e about 2.7% of the world refining capacity. Currently there are about 17 refineries of which 7 are owned by Indian Oil Corporation (IOC), 2 by Hindustan Petroleum Corporation Ltd(HPCL) and Madras Refineries Ltd (MRL), 1 by Bharat Petroleum Corporation Ltd (BPCL), Cochin Refineries Ltd (CRL), Bongaigoan Refinery & Petrochemicals Ltd (BRPL), Numaligarh Refineries Ltd (NRL), Mangalore Refinery & Petrochemicals Ltd (MRPL) and Reliance Petroleum Ltd (RPL).

Sector controls

Given the criticality of oil & gas in the national economy, the sector was completely regulated till 1991. With the ushering of liberalization, the sector was partially opened with decontrol of lubricants, decanalization of several products and permission to parallel marketers to sell LPG and SKO. Currently, administered pricing mechanism is present only in the marketing sector with the government ruling the prices of most petroleum products. With the ballooning demand for petroleum products and no fresh discoveries of oil wells, imports have been continuously swelling. During FY00, India imported 44mton of crude and 12mton of products.

The import bill for FY00, was Rs528bn and if the situation continues, it could have serious repercussions on the balance of payments situation as well as smooth & continuous availability of energy. The only solution to this problem is to attract large investments, both in

terms of capital and technology so as to boost production levels and cater to the growing demand. To do this, all the controls in the sector would have to be removed. The government is also reacting in this direction.

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7. Competitive Strategies

After many years of an oligopolistic marketplace, the domestic LPG segment was finally opened to private players around five years back.

However, it was still not a level playing field. That's because the government LPG players like HP GAS, Bharatgas and Indane still had the advantage of government subsidies in terms of pricing. This coupled with their advantage of reach made the government LPG manufacturers the preferred choice.

Things were soon to change! With government subsidies being withdrawn, service delivery and brand image would be the key drivers for brand consideration.

Hence the need for all the gas companies take the lead in building a relevant and impactful brand position.

Communication strategy

The communication target audience straddled many different target audiences:

- * Current users: prevent switching and use more LPG in lieu of kerosene;
- * Non-LPG users - make them positively pre-disposed towards LPG and LPG into their consideration set;
- * Rural - target rural areas where there is little/no penetration of LPG as a cooking medium; and where cheap and easily available fuels like wood and coal were easily available.

Key insight

Research conducted among housewives threw up an interesting insight.

- * The household manager performs many tasks. She receives help from other family members/hired help for most of these tasks.
- * However the cooking task is something that she handles on her own.
- * 72 per cent are responsible for cooking and cook themselves.
- * And 54 per cent don't receive any help in cooking.

Brand position

- * Given the fact that the housewife has no help in the kitchen the aim of the brand was to position itself as her "expert helper" in the kitchen.
- * A helper who provides efficient service; someone who is accessible and reliable.

Supports

This was supported by the service delivery of:

- * Immediate new gas connection;
- * Refills in 24 hours;
- * 8 am to 8 pm booking and delivery service;
- * Guarantee of right weight.

Creative execution

The position of the "expert helper" was brought alive in the brand mnemonic and the brand statement of all the lpg companies evolved like for HP it 'Ji Haan' , for BP it is 'Energizing Lives' etc

8. Production planning and control

For the Controlled Production of LPG we require the following specifications to be followed :

TABLE 4.4: Requirements for Liquefied Petroleum Gases
(Clause 4.1)

Sr No.	Characteristic	Requirement For			Method Of Test Ref To [P :] Of IS : 1448*
		Commercial Butane	Commercial Butane- Propane Mixture	Commercial Propane	
(1)	(2)	(3)	(4)	(5)	(6)
	Vapour pressure at 65°C, kgf/cm ² gauge (see Note 1)	10 Max	16.87 Max (see Note 2)	26 Max	P : 71
	Volatility: evaporation temperature in °C, for 95 percent by volume at 760 mmHg pressure, Max	2	2	-38	P : 72
	Total volatile sulphur, percent by mass, Max	0.02			P : 34
	Copper strip corrosion at 38°C for 1 hour	Not worse than No. 1			P : 15
	Hydrogen sulphide	Absent			P : 73
	Dryness	No free, entrained water		Shall pass the test	P : 74 (see Note 3)
	Odour (see Note 4)	Level 2	Level 2	Level 2	P : 75

NOTE 1: Vapour pressure may be determined at any other temperature and converted to 65°C by means of suitable vapour pressure-temperature graph. The same can also be determined by analysing the gas by means of a gas chromatograph and then using the composition, the vapour pressure can be calculated at 65°C from the standard values of vapour pressures at various temperatures.

NOTE 2: Each consignment of commercial butane-propane mixture shall be designed by its maximum vapour pressure in kgf/ cm² at 65°C. Further, if desired by the purchaser and subject to prior agreement between the purchaser and the supplier, the minimum vapour pressure of that mixture shall be not lower than 2 kgf/cm² gauge compared to the designated maximum vapour pressure; and in any case the minimum for the mixture shall be not lower than 10 kgf/ cm² at 65°C.

NOTE 3: The presence or absence of free entrained water in commercial butane or commercial butane-propane mixture shall be determined by visual inspection of the sample.

NOTE 4: Subject to agreement between the purchaser and the supplier, odour requirements of LPG may be changed for certain applications where unodourised LPG is required.

CHAPTER - V

COMPARATIVE STUDY OF PRIVATE SECTOR COMPANIES AND PUBLIC SECTOR COMPANIES

1. *Market Share*
2. *Pricing*
3. *Sales*
4. *Quality*
5. *Range of cylinders*
6. *Features of cylinders*
7. *After sales Service*
8. *Past performance*

CHAPTER – V

COMPARATIVE STUDY OF PRIVATE SECTOR COMPANIES AND PUBLIC SECTOR COMPANIES

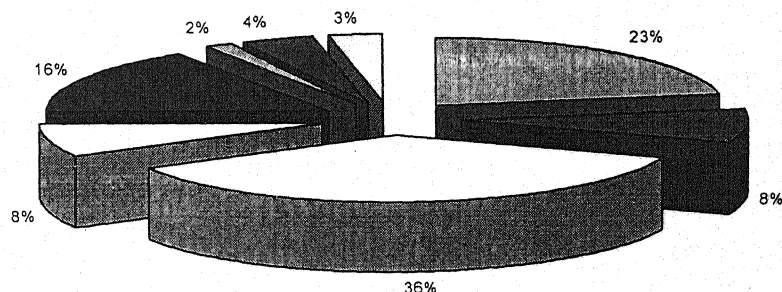
1. MARKET SHARE :

Table: 5.1

Companies Name	Consumption In Kgs
HPCL 19 Kg	32,319
HPCL 14.2 Kg	11,786
BPCL 19 Kg	51,908
BPCL 14.2 Kg	11,346
Shell Gas	23,037
Super Gas	2,414
Indian oil	6,175
Others	4,233
Total	1,43,218

Graphical Representation 5.1 :

MARKET SHARE OF COMPANIES(TOTAL)



□ HPCL 19 KG ■ HPCL 14.2 KG □ BPCL 19 KG □ BPCL 14.2 KG ■ SHELL GAS
□ SUPER GAS ■ INDIAN OIL □ OTHERS

Interpretation:

I found that majority of the market share was with the NOC's and after that was with Shell Gas and others had minor share. The was due to our CVP which we provide to our customer. Market was also effected by the dumping of domestic cylinders in commercial outlets by the NOC's.

2. PRICING

S.No.	Name Of The Company	Price
1	Bharat Petroleum Corporation Ltd	525
2	Hindustan Petroleum Corporation Ltd	523
3	Indian Oil Corporation Ltd	527
4	Shell Gas Pvt Ltd	460
5	Super Gas Pvt Ltd	490
6	Reliance Petroleum Ltd	324

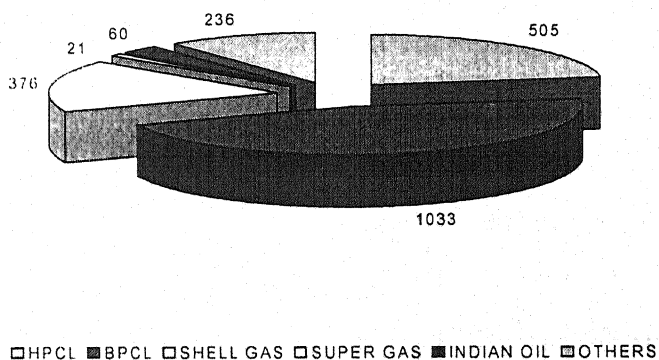
3. SALES

Table 5.2:

Companies name	No of cylinders
HPCL	10330
BPCL	5050
Shell Gas	3760
Super Gas	210
Indian Oil	600
Others	2360
Total	22310

Graphic Representation 5.2 :

MARKET POTENTIAL - COMMERCIAL CYLINDERS



Interpretation: Here, I found out of total demand 22310 Gas cylinders (420.627 tons) biggest share is of BPCL and then HPCL and Shell Gas

4. QUALITY

LPG is a by-product of natural gas processing or a product that comes from crude oil refining and is composed primarily of propane and butane with smaller amounts of propylene and butylenes. Since LPG is largely propane, the characteristics of propane sometimes are taken as a close approximation to those of LPG.

LPG is a liquid petroleum fuel. LPG is a mixture of Butane and Propane, which is gaseous at normal temperature and atmospheric pressure. However for convenience in handling, transporting and storage, it is converted into a liquid form by application of moderate pressure. The cylinder contains a liquid which vapourises at normal atmospheric pressure, and what comes out at the burner head is then gas, which you ignite with a match-stick.

Production:

LPG is a by-product of two sources: natural gas processing and crude oil refining. When natural gas is produced, it contains methane and other light hydrocarbons that are separated in a gas processing plant. Because propane boils at -44 degrees F and ethane boils at -127 degrees F, separation from methane is accomplished by combining increasing pressure and decreasing temperature. The natural gas liquid components recovered during processing include ethane, propane and butane and other heavier hydrocarbons. Propane and butane along with other gases are also produced during crude refining as a by-product of the process that rearrange

or break down the molecular structure to obtain more desirable petroleum compounds.

Emissions:

The main constituent of LPG is propane. Lower carbon-to-hydrogen ratio, higher octane rating and its ability to form a homogeneous mixture inside the combustion chamber enable it to produce lesser emissions compared to conventional fuels. Table-11 gives a comparative emissions status from Euro-II diesel and LPG buses. LPG outperforms conventional fuels in both regulated and non-regulated emissions. Comparison of non-regulated components of emissions between diesel and LPG vehicles is given in Table-12. Non-regulated components of emissions like aldehydes and poly-aromatic hydrocarbons are much lower from CNG vehicles compared to that of diesel vehicles.

Typical Smell of LPG

LPG in its pure component form is odourless. However to make it easily detectable when leaking, a compound called Mercaptan Sulphur is added in such quantities that even at 1/5 th level of the lower explosive limit, the foul smell will be detectable, and you will be impelled to set about correcting it. LPG is colourless as well.

LPG is no more dangerous than any other fuel. As long as you follow the simple and basic procedures in its use it is safe, in fact, far safer as compared to other conventional fuels. LPG will ignite only when air is mixed with it in certain proportions called the explosive

range, which is very narrow. LPG does not ignite, therefore certainly cannot explode, beyond this range.

LPG vapour is nearly twice as heavy as air. In case of a leakage, it would tend to settle at the ground level, which necessitates adequate ground level ventilation where LPG is stored. LPG is lighter than water, hence would float on it.

Comparative Study regarding Quality: Table 5.3

Sr. No	Companies Name	Calorific Value (Kcal/Kg)	Vapour Pressure (Kg/Cm2)	Flow Rate (Gms/kg)
1	BPCL	11675	3.5 – 4.5	635
2	HPCL	11675	3.5 – 4.5	635
3	IOCL	11675	3.5 – 4.5	635
4	SHELL GAS	11800	3.5 – 4.5	650
5	SUPER GAS	11760	3.5 – 4.5	645
6	RELIANCE	11300	3.5 – 4.5	450

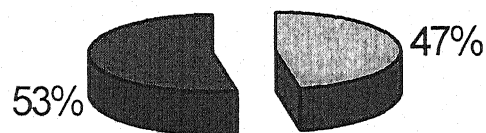
5. RANGE OF CYLINDERS :

Table 5.4:

Commercial cyinder in the outlets	No of cylinders
Commercial cylinder	21300
Domestic cylinder	24000

Graphic Representation 5.3:

DEMAND OF CYLINDERS



□ COMMERCIAL CYLINDERS ■ DOMESTIC CYLINDERS

Interpretation :Here, I found that the supply of domestic cylinders in commercial outlets are drastically affecting the sale of commercial cylinder because in total demand the commercial cylinder demand is just 35%.

6. FEATURES OF CYLINDERS :

Various types of cylinders being marketed by the PSU Oil Companies

There are 3 types of cylinders being currently marketed - the 14.2 kg, 19 kg and 47.5 kg capacity .Domestic users and exempted category of commercial users are supplied the 14.2 kg cylinders, while the 19 kg and 47.5 kg cylinders are meant exclusively for commercial and industrial use.

These cylinders are manufactured only by the approved manufacturers, under the supervision of BIS inspectors and are certified by the Controller of Explosives. While all cylinders are spray painted with a signal red Colour, BPC cylinders have a yellow ring around the bung, HPC cylinders a blue ring, and IOC cylinders are fully red. In case of the 19 kg cylinders, the top is painted olive green.

The cylinders carry their complete history with regard to their serial number, tare/ gross weight, water capacity, ISI monograms, test dates, manufacturer's identification and year of manufacture.

Booking for a new connection

Do's

Approach the distributor catering to your area of residence and register your name in the waiting list available there. Please carry with you a proof of your residence. This procedure is identical for both existing (old) distributors as well as for new distributors.

Don'ts

Pay any money at the time of booking. New connection bookings are free of charge.

7. AFTER SALES SERVICE

You can book for a refill through more ways than one - telephone call, post-card to distributor, booking slip through refill booking box or personal visit to the showroom. For a round-the-clock service, additional facilities like telephone answering machine, computer-operated voice mail are also provided. Where the distributor's area is very large, refill booking boxes have been-provided so as to ensure ease of refill booking.

Your-consumer number

Please remember your correct consumer number to speed-up the booking process. Also you will be provided a booking number pertaining to your refill booking which will be your password for enquiries at a later date.

Home Delivery

Your cylinders will be delivered to your kitchen-what we call home-delivery. Only under exceptional conditions e.g. labour unrest, transport problems, operational constraints at the bottling plant etc., can the distributor resort to deliveries on cash-and- carry basis, and that too with prior approvals from the Oil Company. The applicable rebate will be given on 'cash-and- carry' supplies.

Safety while using LPG

Our twin objectives are 'Safety' and 'Consumer Satisfaction'. The importance of safety in marketing of LPG cannot be over-emphasised. Emphasis on safety does not mean LPG is dangerous. As stated earlier, handled with care, it is as safe as any other fuel. To go a step further, we would like to assure you that neither LPG

nor its end products post-burning, in a suitable appliance, are poisonous.

In addition to the in-built safety valves in the system there are other safety precautions which the consumer needs to be aware of.

In your kitchen

You are given safety literature and instructions on the safe and economical use of LPG, at the time of release of a new connection. A list of Dos and Don'ts accompanies it. We would be happy and satisfied if you read it.

Do not forget to switch off pressure regulator knob whenever LPG is not in use

Field Officers visit customers' premises to ascertain the safety and service aspects. They are instructed to carry out corrective action wherever required.

When you receive a refill, the delivery boy has to break open the seal in your presence and test for leaks, if any. He is also supposed to connect the cylinders to the installation and check for proper functioning. Checks for leaks at the rubber tube joints and at the bung are also required to be carried out. If your delivery boy does not carry out these, you have a right to insist on them.

In addition, you are entitled to a mandatory inspection once in 2 years, against a fee of Rs. 10 - payable to the distributor. A trained mechanic will inspect your LPG installation and fill out a detailed

form, pronouncing it 'safe' in all respects. He is also authorized to take corrective action wherever necessary.

At Distributor's godown

Every cylinder received from the bottling plant, is checked for body leaks, bung leaks and weight, and only then delivered to your kitchen.

At the Bottling Plant

The bottling plant has its own system of stringent safety and quality control checks built-in at different stages. The quality control checks at the bottling plant are carried out at 3 stages - pre-filling, post-filling and statistical quality control checks before loading of cylinders into trucks, headed for the distributors' godowns.

The pre-filling checks include segregation of damaged cylinders, spurious cylinders, cylinders with missing O-Rings and cylinders due for pressure testing. The cylinders are then washed and sent for filling on fully automatic machines.

In the post-filling checks, it is ensured that all the cylinders filled on the automatic cut-off weighing scale/filling machines are subjected to 100% cross- checks for weight. A check (the Compact Valve Test) is carried out for detecting valve leaks and leaks on account of damaged O- rings, if any. The cylinders after being capped, are passed through a water bath for detecting bung leaks and body leaks. The sound cylinders are then sealed and kept ready for dispatch.

Prior to loading the filled cylinders on to the trucks, random statistical quality control checks of at least 2% of the filled cylinders are carried out. these checks include all pre-filling and post-filling Checks already enunciated above, in addition to checking the quality of the seal.

For an objective viewpoint, the Oil Industry Technical Committee meets every month to discuss and evaluate decisions on technical and quality issues relating to LPG equipment.

Another team - the Oil Industry Technical Audit Committee also visits the equipment manufacturers twice a year to ensure that all equipment is manufactured in conformity to the laid down standards. If defaults are observed, the manufacturer in question is disqualified or suspended from the list of approved manufacturers.

Every cylinder received from a distributor or transporter is subjected to a check for genuineness. Penal actions are initiated wherever lapses are observed.

Cylinders are subjected to Hydraulic and Pneumatic testing at periodic intervals to ascertain fitness.

Training of Delivery boys

The Oil Companies keep trying to achieve high safety standards through conducting regular in-depth training courses and refresher programmes for the delivery boys. It is a constant endeavour of the Oil Companies to train delivery boys in the safe handling of LPG equipment and in identifying spurious cylinders from genuine ones.

Safety Clinics

Safety Clinics are conducted periodically by Sales Officers to refresh safe handling and conservation aspects. Safety films are shown to customers and literature on safety is distributed at these clinics.

Training to students

Safety training is imparted, in particular, to girl students between classes IX and XII. The intention is to train all future housewives in the basics of safety and conservation.

Safety Week

All Oil Companies observe the "Safety Week" to lay special emphasis on all safety aspects.

Free Inspection Week

Oil Companies also offer free inspections of installations for one week every year. This is publicised in advance for the benefit of customers.

R & D

The Oil Industry has established a centralised institute, called the "LPG Equipment Research Centre" for updation of LPG equipment in pursuit of constant research, development and transfer of technology to the manufacturers of LPG equipment.

Putting our own house in order

Greater emphasis is laid on training and development of field officers, bottling plant staff, distributors' and transporters' staff. Our

Field staff also regularly checks for updation of licences from Statutory Authorities. Customers are requested to co-operate by not accepting LPG cylinders from sources other than their own distributors.

Gas Adalats - In order to have a direct interaction between our consumers and distributors for on-the spot redressals, Oil Companies organise Gas Adalats at various locations.

Although the Gas Adalat is only a larger version of the customer service cell, the concept has been acclaimed by the consumers' organisations since it provides an opportunity to resolve the issues in the presence of all concerned, under one roof.

In addition to the above, the Sales Officers during their weekly visits on pre-determined days to a distributorship, redress customers grievances pertaining to that particular distributor. The Sales Officers also visit customers' premises on random basis to ascertain safety and service aspects.

In case none of the above are convenient, please write to the concerned Oil Company on pre-printed inland letters (with the Divisional office's address endorsed on it) for redressal of your grievances. These are available with your distributor.

CHAPTER VI

ANALYSIS OF SURVEY DATA

CHAPTER VI

ANALYSIS OF SURVEY DATA

1. Source : Question no 6(a)

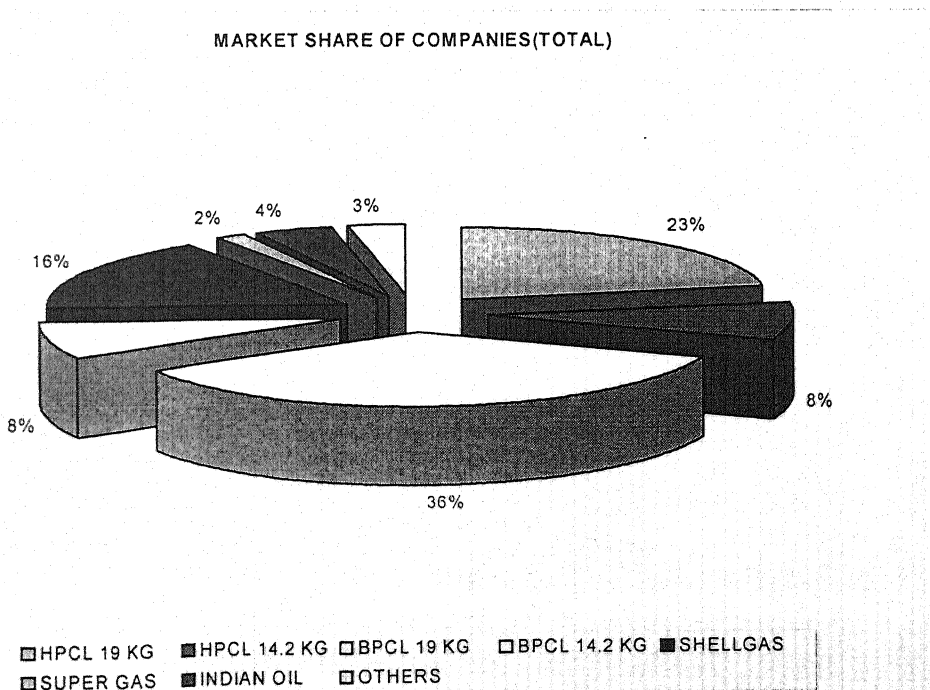
Purpose :

To know the market share LPG companies

Table 6.1:

Companies Name	Consumption In Kgs
HPCL 19 Kg	32,319
HPCL 14.2 Kg	11,786
BPCL 19 Kg	51,908
BPCL 14.2 Kg	11,346
Shell Gas	23,037
Super Gas	2,414
Indian oil	6,175
Others	4,233
Total	1,43,218

Graphical Representation 6.1:



Interpretation:

I found that majority of the market share was with the NOC's and after that was with Shell Gas and others had minor share. The was due to our CVP which we provide to our customer. Market was also effected by the dumping of domestic cylinders in commercial outlets by the NOC's.

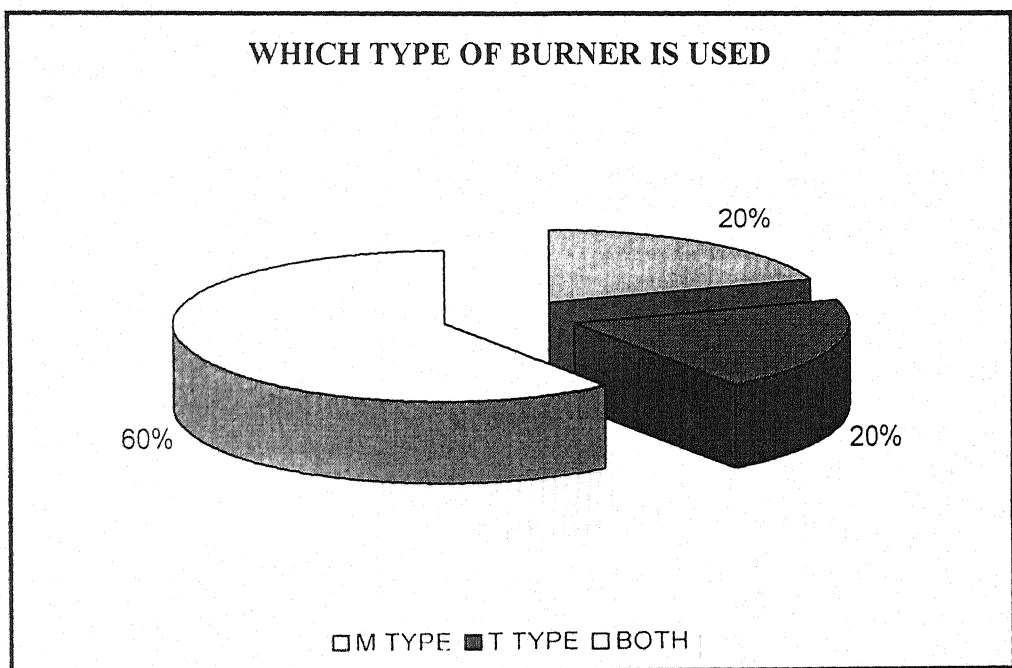
2. Source :Question no.6(d)

Purpose : To identify which type of burner is used heavily in the market

Table 6.2:

Type of burner	No. of person
M Type	91
T Type	90
Both	272
Total	453

Graphic Representation 6.2 :



Interpretation: Here, I found that the majority of people are using both the types of burner at a time

3. Source : Question no.6(h)

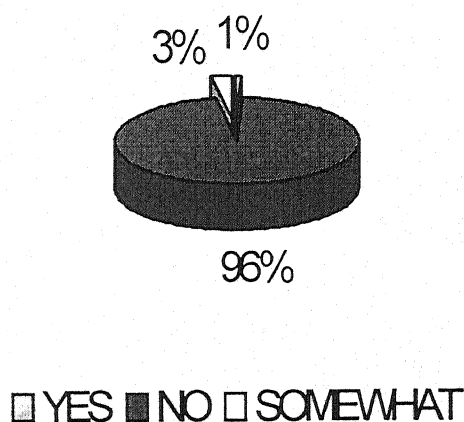
Purpose : To identify how many people are aware of the properties of the LPG so that they can be made aware to understand our quality. Out of 453 only 17 knew about LPG properties and others didn't.

Table 6.3 :

Reaction of people	No of persons
Yes	2
No	192
Somewhat	6
Total	200

Graphic Representation 6.3:

AWARENESS OF LPG PROPERTIES



Interpretation:

Here I found that the majority of people were not aware of the properties of LPG and out others some knew about it and some has a rough idea.

4. Source : Question no 6(i)

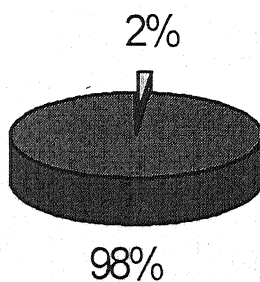
Purpose : To identify how many people are aware of the wastages occurring in LPG

Table 6.4:

Awareness of people about LPG	No of persons
Yes	4
No	196
Total	200

Graphic Representation 6.4 :

AWARENESS OF WASTAGES IN LPG



□ YES ■ NO

Interpretation:

Majority of people think there is no wastage in LPG .Out of 200 only 4 people thought their was wastages in LPG and others didn't.

5. Source :Question no.6(I)

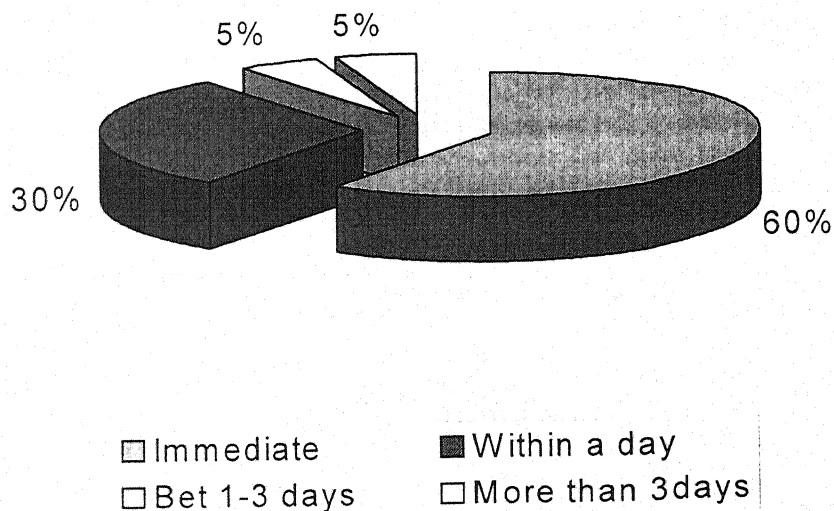
Purpose : To identify which will be the best delivery time for the customer

Table 6.5 :

Delivery time required	No of persons
Immediate	120
Within a day	60
Between 1-3 days	10
More than 3 days	10
Total	200

Graphic Representation 6.5:

DELIVERY TIME GIVEN



Interpretation :Here,I found that the majority of people do not maintain stock and need immediate delivery time

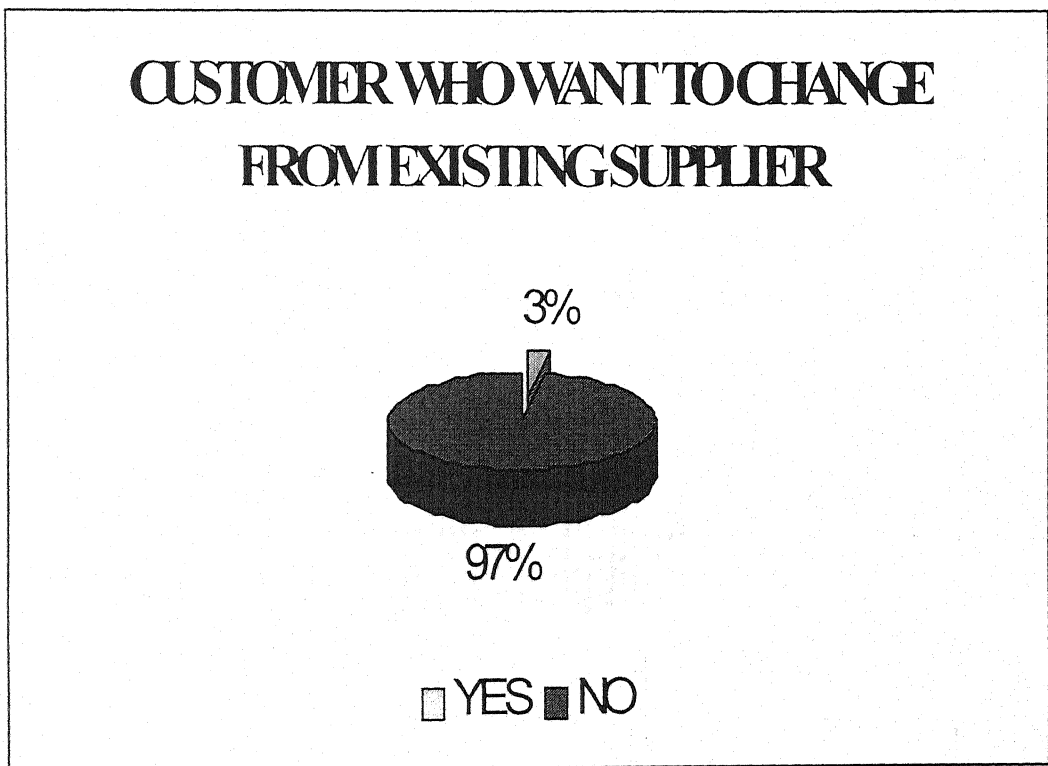
6. Source :Question no.6(m)

Purpose : To identify How many customer want to change their existing supplier and for what reason.

Table 6.6:

Customer who want to change	No of persons
Yes	6
No	194
Total	200

Graphic Representation 6.6:



Interpretation :Majority of people did not wanted to change their existing supplier but continues follow ups can reduce the number.Out of 200 ,7 customers wanted to change their existing supplier.

7. Source :Question no.7(a)

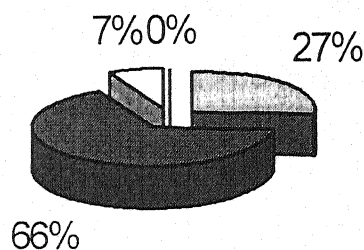
Purpose : To identify the ratio of consumption of other fuel other than LPG.

Table 6.7 :

Others fuel used for production	No of persons
SKO	11
HSD	27
LDO	3
Petrol	0
Total	41

Graphic Representation 6.7:

OTHER FUEL USED FOR PRODUCTION



□ SKO ■ HSD □ LDO □ PETROL

Interpretation:

I found that the majority of people are consuming HSD and then SKO, the sample size for this was 41 customers.

8. Source :Question no.7(c)

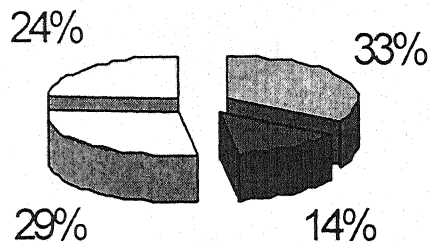
Purpose : To identify the people with maximum consumption of other fuel per month.

Table 6.8:

Consumption of fuel	No of persons
Less than 150 ltr	14
Bet 150 – 300 ltr	6
Bet 300 – 600 ltr	11
More than 600 ltr	10
Total	41

Graphic Representation 6.8:

CONSUMPTION OF FUEL



□ LESS THAN 150 ■ 150-300 □ 300-600 □ MORE THAN 600

Interpretation :I found some major people who will be beneficial for the company when converted.The sample size for this calculation was 41 customers.

9. Source :Question no.7(i)

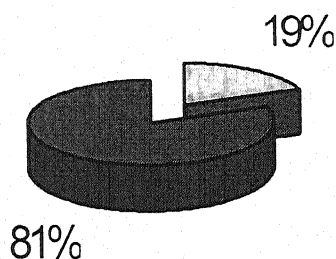
Purpose : To get the productive customers for conversion.

Table 6.9:

People who want to switch	No of persons
Yes	8
No	33
Total	41

Graphic Representation 6.9 :

PEOPLE WHO WANT OT SWITCH TO LPG



■ YES ■ NO

Interpretation :Here,I got 19% of productive customers,and others were not conform about their savings,some thought LPG affects the taste of the sweets.The sample size for this was 41 customers.

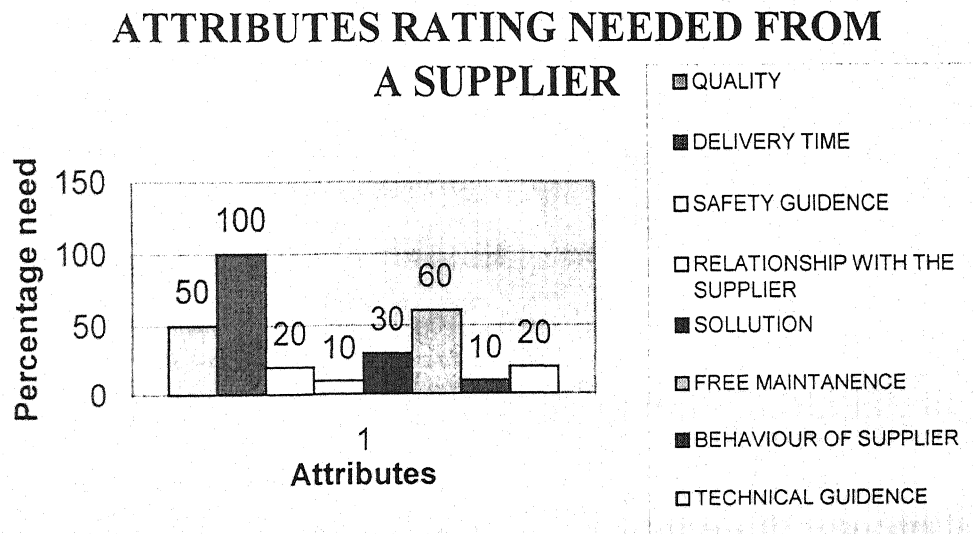
10. Source :Question no.8

Purpose : To identify the top three attributes which a customer needs in a LPG supplier

Table 6.10 :

Attributes needed by the customers	Degree of their need
Quality	50
Delivery time	100
Safety guidance	20
Relationship with the suppliers	10
Sollution provider	30
Free maintenance	60
Behaviour of supplier	10
Technical guidance	20

Graphic Representation 6.10 :



Interpretation :

Here,I found that the majority of people went for delivery time then quality and then free maintenance.

11. Source :Question no.6(a)

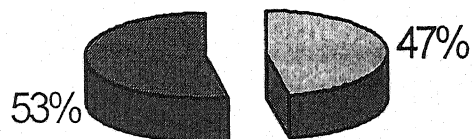
Purpose : To identify How are the supply of domestic cylinder in commercial outlets are affecting the demand of commercial cylinders.

Table 6.11:

Commercial cyinder in the outlets	No of cylinders
Commercial cylinder	94
Domestic cylinder	106

Graphic Representation 6.11

COMMERCIAL CYLINDERS DEMAND IN COMMERCIAL OUTLETS



■ COMMERCIAL CYLINDERS ■ DOMESTIC CYLINDERS

Interpretation :Here,I found that the supply of domestic cylinders in commercial outlets are drastically affecting the sale of commercial cylinder because in total demad the commercial cylinder demand is just 35%.

12. Source :Question no.6(a)

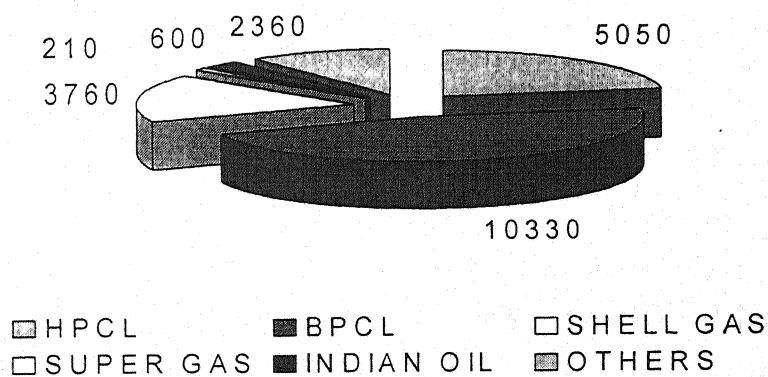
Purpose : To identify the market potential of commercial gas cylinders in Total Market.

Table 6.12:

Companies name	No of cylinders
HPCL	10330
BPCL	5050
Shell Gas	3760
Super Gas	210
Indian Oil	600
Others	2360
Total	22310

Graphic Representation 6.12:

MARKET POTENTIAL - COMMERCIAL CYLINDERS (TOTAL MARKET)



Interpretation :Here,I found out of total demand 22310 Gas cylinders (420.627 tons) biggest share is of BPCL and then HPCL and Shell Gas

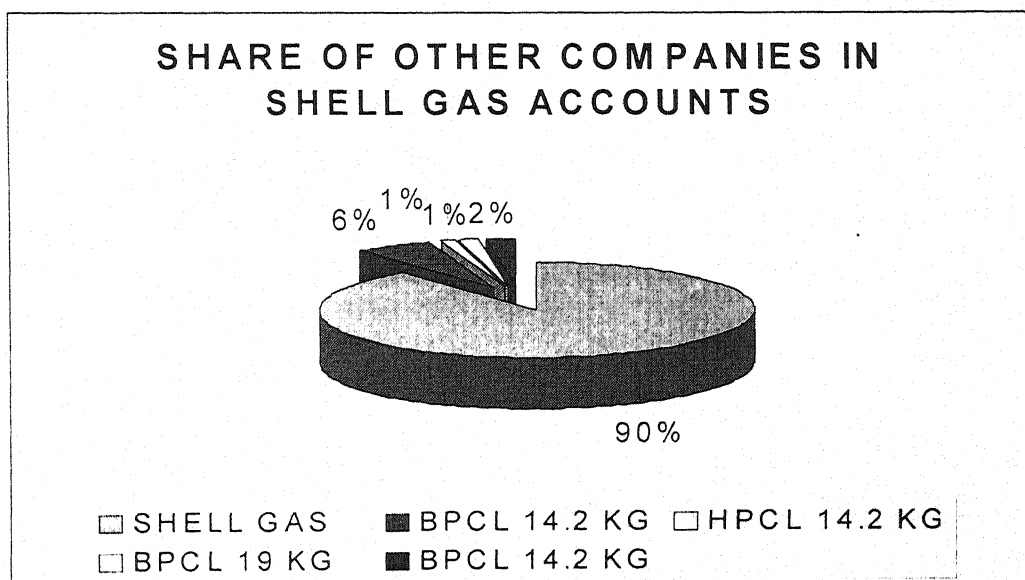
13. Source :Question no.6(a)

Purpose : To identify the share of other companies in the shell gas accounts.

Table 6.13:

Companies name	Share (in tons)
Shell Gas	230.037
HP 14.2 kg	10.252
HP 19 kg	10.570
BP 14.2 kg	10.520
BP 19 kg	10.380
Total	271.759

Graphic Representation 6.13 :



Interpretation :

Here, I found out of total demand 271.759 tons and in this the share of shell gas was of 230.037 tons, HP 14.2 kg-10.252 tons, BP 14.2 kg-10.520 tons, BP 19 kg – 10.380 tons, HP 19 kg – 10.570 tons.

CHAPTER VII

CONCLUSIONS,

SUMMARY OF BROAD FINDINGS &

RECOMMENDATIONS

CONCLUSIONS

Philip Kotler, the acknowledged guru of marketing, defines marketing as: *"a social and managerial process by which individuals and groups obtain what they need and want through creating, offering, and exchanging products of value with others"*.

Others have said that company marketing skills can launch a new era of high economic growth and living standards.

It may be noted that contributions discussed in this chapter are not exhaustive list of scholars in the field of Marketing, but an attempt has been to incorporate the major contributions.

Both ideas are built upon the Marketing Concept that was introduced in the mid-1950s, which states: *"The marketing concept holds that key to achieving organizational goals consists in determining the needs and wants of target markets and delivering the desired satisfaction more effectively and efficiently than competitors"*.

Again quoting Kotler, *"Marketing management is accomplished by carrying out marketing research, planning, Implementation, and control"*. Meaningful marketing and strategic planning relies on management's ability to develop and maintain a marketing information system and have the skills to carry out sound marketing research.

1. If marketing is the engine that drives the economy, then marketing research is the process that keeps the engine tuned.

2. Classical marketing research is gathering data about goods and services

- The emphasis on marketing is on the identification and satisfaction of customer needs.
- In order to determine customer needs and for implementing marketing strategies and programs aimed at satisfying those needs, marketing managers need information. They need data about customers, competitors, and other forces in the marketplace.
- The task of marketing research is to assess the data needs and to provide management with relevant, accurate, reliable, valid, and current data.
- Recently research firms have been requested to analyze the data and provide marketing intelligence and information.
- Importance of research can be gauged by the wide range of organizations that use marketing research:
 - ◆ Small businesses
 - ◆ Large businesses
 - ◆ Manufacturing companies
 - ◆ Technology companies
 - ◆ On-line marketers
 - ◆ Policy makers
 - ◆ Professional services
 - ◆ Non profit organizations
 - ◆ Government Organizations

Marketing research, as a profession, has made many important contributions to the marketing process. Marketing research has been used to hasten the introduction of successful new products and services to the market place.

New ideas and concepts have been screened before businesses make huge investments in plant and material on products which consumers would not support. Product formulations have been improved by means of consumer input through various research techniques. In fact, the industry has played a major role in managing every aspect of the marketing mix, from pricing to promotion for the world's leading manufacturers and service organizations.

Marketing is a comprehensive term and it includes all resources and a set of activities necessary to direct and facilitate the flow of goods and services from producer to consumer in the process of distribution. Businessmen regard marketing as a management function to plan, promote and deliver products to the clients and customers.

The American marketing Association defines marketing as a process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives.

Paul Mazur defined marketing as the creation and delivery of a standard of living to the society. This definition catches the real spirit of the marketing process. It has consumer orientation and duly honors the

marketing concept, which indicates a shift from product to customer orientation, i.e. fulfillment of customer's needs and desires.

Marketers all over the world are witnessing an unlimited potential for global business and marketing development. The present marketing environment is so turbulent and dynamic that it requires a correct pool of marketing mix. The marketing universe has undergone tremendous changes in the economic, technological, social and political spheres. In a fast changing environment, marketing management has to meet the challenge of managing the change, achieve progress and prosperity through marketing innovations.

Hence, integrated marketing planning and strategies will be the key to the survival of free enterprise system. The managerial marketing buyers of any organization today stresses the reality of new marketing era, which is synthesis of customer needs, business and social interests.

The international LPG industry has expanded rapidly over the past decade and undergone many profound changes. Utilization of LPG as fuel in residential and commercial markets has more than doubled in many developing countries. LPG consumption has expanded at nearly twice the rate of world petrochemical demand, and LPG demand has now surpassed jet fuel consumption on a global basis. Markets for LPG (and other petroleum products) have been opened in many countries, accelerating demand growth rates and creating investment opportunities in all segments of the downstream LPG industry -- including terminaling, storage, distribution and marketing.

The prospects for the international LPG industry appear promising as we approach the next millennium. Markets for LPG in developing countries should continue to expand as more and more customers are introduced to LPG and infrastructure is added to efficiently distribute and market the product. While LPG consumption has already grown quickly in several emerging markets, per capita LPG consumption in most developing regions remains substantially below consumption patterns in well-established markets such as Japan, North America and Western Europe. Thus, significant growth potential remains in developing countries such as China and India.

The petrochemical industry has experienced a period of sustained strong expansion over the past decade, significantly increasing the need for feedstocks. As a result, the base demand for LPG feedstocks (in plants specifically designed for LPG and/or ethane) has grown rapidly and the ability of flexible petrochemical plants to absorb LPG supplies available for price-sensitive markets has steadily risen. The petrochemical industry is having a particularly important influence on LPG markets in North America, Western Europe, and the Middle East. The petrochemical feedstock market is expected to remain a strong growth market for LPG (and other feedstocks such as naphtha and ethane) over the medium to long-term as global petrochemical demand growth continues to outpace energy demand growth.

As discussed above, the prospects for continued expansion of the LPG industry into new and traditional markets appear reasonably strong. However, there are several uncertainties that will probably influence the development of the global LPG market as well as regional markets. The Asian financial crisis will undoubtedly result in some economic changes

in countries that are directly involved in the crisis, and it may spill over into other Asian economies that are not directly involved in the crisis. This could have a potentially significant impact on LPG demand growth in several countries over the short to medium term and might delay or cause cancellation of regional supply projects.

Petroleum products play a vital role in every industry. Barring LPG with nearly 85% domestic consumption, all other products used across industries.

In country with 1000mn population the LPG customer is about 40mn. This is a market, which is expected to register a CAGR of 12% for next five years (2006).

The present players in LPG market are HPCL, BPCL, SHV, SHELL GAS, and RELIANCE.

LPG predominantly consists of saturated hydrocarbons –propane and butane.

Liquefied petroleum gas (LPG) is an efficient and clean medium of energy. Apart from its use as cooking fuel world over, the product has several application such as running automobiles, operating consumer durables like washing machines, room heaters, air conditioners etc.

In India LPG was primarily used as a cooking fuel in urban and semi – urban areas. Ironically, in a country with a population of 1000mn this efficient cooking medium has reached only 28mn household (as per 1991 census) then LPG connections should reach at least 54mn household, which translates into additional 5.2mtpa (millions ton per annum) of LPG consumption. Further, if 20% of rural population start

consuming LPG, it would work to another 20mn households, which means an additional requirement of 4.18mtpa of LPG .As per the industry sources back of the envelope calculations suggest that if 40mn households in India own color television (CTV) then the LPG connection should easily double, yet LPG penetration is skewed towards certain areas – couple of reasons for the same:

- Government encouraged maximum production of middle distillates i.e. HSD (High Speed Diesel) and SKO (Superior Kerosene Oil) therefore, LPG production on an average was about 3-4% of the crude processed.
- Infrastructure bottlenecks-Limited investment were directed towards developing storage and bottling facilities. PSU's(Public Sector Undertakings)had the practice of Rationing LPG connections for semi –urban areas, talukas and other smaller districts due to lack of sufficient storage facilities, refilling problem etc.
- Subsidizing policy discouraged private investments.

Four Public Sector Oil Marketing Companies (OMCs) viz., Indian Oil Corporation Limited, Bharat Petroleum Corporation Limited, Hindustan Petroleum Corporation Limited and IBP Co. Limited are engaged in marketing of LPG in the country. With increased availability of LPG, the number of LPG customers enrolled by them has also been increasing. The number of LPG customers served by them, as on 1.4.2005, was about 845 lakh through their network of 9,001 LPG distributors.

Consequent upon liquidation of LPG waiting list in urban areas and availability of new LPG connections across the counter, in existing markets throughout the country, OMCs had set the target for release of about 63 lakh new LPG connections during financial year 2004-05 with a thrust on smaller towns/rural areas which were hitherto virgin markets. OMCs have already commissioned 535 distributorships. During the year 2004-05, OMCs had released about 73 lakh new LPG connections and commissioned 675 LPG distributorships.

Three types of cylinders have been manufactured by the companies:

1. Domestic LPG Cylinder
2. 19 Kg Commercial Cylinder
3. 47.5 Kg Industrial Cylinder

Market Segmentation

The purpose for segmenting a market is to allow your marketing/sales program to focus on the subset of prospects that are "most likely" to purchase your offering. If done properly this will help to insure the highest return for your marketing/sales expenditures. Depending on whether you are selling your offering to individual consumers or a business, there are definite differences in what you will consider when defining market segments.

The first thing you can establish is a category of need that your offering satisfies. The following classifications may help.

For businesses:

- Strategic - your offering is in some way important to the enterprise mission, objectives and operational oversight. For example, a

service that helped evaluate capital investment opportunities would fall into this domain of influence. The purchase decision for this category of offering will be made by the prospect's top level executive management.

- Operations - your offering affects the general operating policies and procedures. Examples might be, an employee insurance plan or a corporate wide communications system. This purchase decision will be made by the prospect's top-level operations management.
- Functional - your offering deals with a specific function within the enterprise such as data processing, accounting, human resources, plant maintenance, engineering design, manufacturing, inventory control, etc. This is the most likely domain for a product or service, but you must recognize that the other domains may also get involved if the purchase of the product or service becomes a high profile decision. This purchase decision will be made by the prospect's functional management.

For the individual consumer:

- Social Esteem or Pleasure - your offering satisfies a purely emotional need in the consumer. Examples are a mink coat or a diamond ring. There are some products that are on the boundary between this category and the functional category such as a Rolex watch (a Timex would satisfy the functional requirement and probably keep time just as well).
- Functional - your offering meets a functional requirement of the consumer such as a broom, breakfast cereal or lawnmower.

Market Positioning is a perceptual location. It's where your product or service fits into the marketplace. Effective positioning puts you first in line in the minds of potential customers.

As individuals, we continually position ourselves. The responsible older sibling, the class clown, a number cruncher, a super genius are all examples of positioning. These identifiers help us define ourselves and distinguish our abilities as unique and different from other people.

Positioning is a powerful tool that allows you to create an image. And image is the outward representation of being who you want to be, doing what you want to do, and having what you want to have. Positioning yourself can lead to personal fulfillment. Being positioned by someone else restricts your choices and limits your opportunities.

Primary energy is a critical input and in line with economic growth, as observed since the late seventies. The world consumption of energy increased from about 4,800 million metric ton of oil equivalent (mmtoe) in 1970 to about 8,477 mmtoe in 1999, representing a CAGR of about 1.98%. The growth in consumption would have been much higher but for the disintegration of the former Soviet Union, whose energy consumption levels dropped by more than 35% in the last five years.

LPG is a by-product of natural gas processing or a product that comes from crude oil refining and is composed primarily of propane and

butane with smaller amounts of propylene and butylenes. Since LPG is largely propane, the characteristics of propane sometimes are taken as a close approximation to those of LPG.

LPG is a liquid petroleum fuel. LPG is a mixture of Butane and Propane, which is gaseous at normal temperature and atmospheric pressure. However for convenience in handling, transporting and storage, it is converted into a liquid form before application of moderate pressure. The cylinder contains a liquid which vapourises at normal atmospheric pressure, and what comes out at the burner head is then gas, which you ignite with a match-stick.

There are two components of LPG: Propane and Butane.

Propane has a lower boiling point than butane, so will continue to convert from a liquid to a gas even in very cold condition. When stored as a liquid in a cylinder or tank, it exerts a greater pressure than butane at the same temperature.

	PROPANE	BUTANE	NATURAL GAS
Normal Gas to air required for burning	1:24	1:30	1:9.6
Boiling point	-45	-2	-162
Gross calorific value (K Cal/kg)	10872	14570	13620

Domestic Use:

Cooking, Home Heating, Water Heating, Lighting, Air Conditioning, Refrigeration etc

Agricultural Use:

Crop drying, Poultry Brooding, Defoliation, Tobacco Aeration, Incineration, Tractor Operation, Crop Heating.

Industrial Use:

Heat Treatment, Paint Drying, Portable Heating, Glass Blowing Incineration, Flame Cutting, Core Baking Flame, and Hardening.

Automotive Fuel:

Taxi's, Buses, Forklifts

LPG exists as a gas at normal atmospheric pressure and temperature, only existing in its liquid form at very low temperature or alternatively under pressure. Normally, the gas is stored in liquid form under pressure in a steel cylinder or tank.

When the pressure is released normally when gas supply valve is turned on the liquid will boil and form a vapour. This same principle applies whether the gas is in a tiny camping cartridge or in a large industrial storage vessel.

Liquid boiling in the cylinder forms a vapour, which is used to fuel appliances.

Heat is needed to convert the liquid to gas, known as the latent heat of vapourisation. As the liquid boils, it needs to take heat energy from itself and its surroundings. This is why containers feel cold to touch and if there is a high gas off take, frost may appear on cylinder.

Pressure increases the temperature, so if the temperature around the cylinder or tank increases so will the pressure inside the tank as the liquid expands. Bulk Tanks are normally fitted with a pressure relief valve to release any extreme build up of pressure safely.

The chemical composition of propane is C_3H_8 and of butane C_4H_{10} because makeup of each of the gas inevitably contains traces of other gases or impurities, there may be small variances in the exact composition.

LPG vapour is heavier than air, which has important safety implications. Any leakage will sink to the ground and accumulate in low-lying areas and may be difficult to disperse, so

LPG should never be stored or used below ground level.

LPG has no smell and has a strong 'stenching' agent added before delivery to help detection of any leaks. LPG is flammable in air and although non-toxic, large quantities may cause suffocation.

LPG is a high performance fuel, but will only ignite with a quantity of air in roughly a gas: air ratio of between 1:50 and 1:10, lower than the limits for natural gas.

The calorific value of LPG is about 2.5 times higher than that of natural gas, so more heat is produced from the same volume of gas.

LPG is chemically reactive and will cause natural rubber and some plastics deteriorate. Only equipment and fitting specifically designed for LPG should be used.

Various types of cylinders being marketed by the PSU Oil Companies

There are 3 types of cylinders being currently marketed - the 14.2 kg, 19 kg and 47.5 kg capacity. Domestic users and exempted category of commercial users are supplied the 14.2 kg cylinders, while the 19 kg and 47.5 kg cylinders are meant exclusively for commercial and industrial use.

These cylinders are manufactured only by the approved manufacturers, under the supervision of BIS inspectors and are certified by the Controller of Explosives. While all cylinders are spray painted with a signal red Colour, BPC cylinders have a yellow ring around the bung, HPC cylinders a blue ring, and IOC cylinders are fully red. In case of the 19 kg cylinders, the top is painted olive green.

The cylinders carry their complete history with regard to their serial number, tare/ gross weight, water capacity, ISI monograms, test dates, manufacturer's identification and year of manufacture.

Through the survey conduction I found that majority of the market share was with the NOC's and after that was with Shell Gas and others had minor share. The was due to our CVP which we provide to our customer. Market was also effected by the dumping of domestic cylinders in commercial outlets by the NOC's.

The supply of domestic cylinders in commercial outlets are drastically affecting the sale of commercial cylinder because in total demand the commercial cylinder demand is just 35%.

FINDINGS

- The largest market share is with the NOC's and after that was Private Companies. This was due to our CVP, which private companies provide to the customers. Market was also affected by the dumping of domestic cylinders in commercial outlets by the NOC's.
- Now when the subsidies are being removed by the government for the NOC's they all are facing tough competition against the private players because NOC's are not used to customer satisfaction but now each and every company is trying to satisfy their consumers.
- All the companies are trying to create a Brand Image in the consumers mind by positioning their product in different ways.
- Most of the people are using both M Type and T Type burner at the same time.
- Most of the people are not aware of the properties of LPG and others just have a rough idea thus they can be easily misled.
- Most of the people think there is no wastage in LPG but there is wastage in it.

- Most of the people do not maintain stock and need immediate delivery time
- Most of the people did not want to change their existing supplier but continuous customer dissatisfaction can lead them to do the same.
- Most of the people are consuming HSD and then SKO than LPG.
- Most of the people went for delivery time than quality and then free maintenance.

RECOMMENDATIONS

The suggestion part includes overall study and analysis of the market. The times on my disposal were too short and in this short span of time it is little difficult to give a firm suggestions. But as per my analysis the suggestions are as follows:

- Oil Companies should introduce new distributors without dealers for Dense Market so that they can provide more credit to the customer.
- Oil Companies should organize meetings of the channel members for their motivation, it should also send them greeting cards, gifts and appreciation letters from the head office.
- Oil Companies should give incentives to their customers directly from the company through the distributor on increasing their consumption.
- Private Oil Companies need not invest in advertising but they should publicize their policies, achievement etc through

Newspapers write-ups, Seminars and Newsletters to the customers.

- Looking at the gaps in Pune, Nasik, Nagpur & Mumbai market. A Market Storming activity would help in giving a quantum jump in commercial volumes to Oil Companies.
- Conversion of Diesel to LPG has enormous opportunity, looking at this companies should introduce new channel only for conversion or should plan altogether different strategy for conversion customers with the existing distributors.
- The Government should remove subsidy from the NOC's then only the market will become competitive and customers will be more benefited.
- The NOC's Dealer should not dump their domestic cylinders in the commercial outlets so as commercial outlets should purchase commercial cylinder.
- Private companies should concentrate on the service part so as to satisfy consumers to the utmost level so as to be competitive with the NOC's.

- Private companies should go in for appointing more and more dealers by reducing their margins to capture all the market.
- Private companies should have parallel sales team on the company rolls so as to bust the companies sales.
- Public companies should also consider service to the consumers as very important issue because if once the subsidy is removed by the government then they will lack really behind the private companies.
- Public companies should also start plan for a sales team who can go and meet the end users directly on the companies behalf so as to boost the sales after the subsidy is removed.
- In todays scenario when the subsidy is given there is imperfect competition in the market between the Private and Public companies thus the private companies should strong their infrastructure and wait patiently for the subsidy removal.
- The quality of LPG should also be improved by the public companies so as to reduce wastages from the cylinder.
- The packing of the cylinder should also be improved so as there should not be any mal practices done by the dealers.
- In the advertisement done by the public companies they should show the advantages of LPG over HSD and SKO so as the people

who are using HSD and SKO should get converted to LPG to reduce pollution.

- The usage of Commercial Cylinders in the commercial outlets should also be highlighted in the advertisements and the legal punishment held on not doing it, to boost the sale of commercial cylinder.
- The public companies should take into consideration the delivery time taken by their dealers to supply cylinders to the consumers because majority of consumers want the delivery time to be minimum.
- Private companies should also try to create a Brand Image for there product as the Public Companies are doing so as to boost the sales.
- Oil Companies should give personnel advice to there consumers through keeping customer service executive for the purpose of telling them which type of burner to be used , how the cylinders assembly should be installed, which type of layout will be suitable for them for LPG.
- Public companies should start controlling their dealers more aggressively so as to stop mal practices.
- Oil companies should now have offices will great interior so as to impress the consumers because first impression is the last impression.

- Oil Companies should go in for better call centre for consumers so as there problems are solved them and there.
- Private companies should also start think over changing the size of there cylinder to the size of public companies so as the consumers should feel that they are not changing anything because people generally resist change.
- Oil companies should advertise about the other uses of LPG i.e. Crop Drying, Poultry Brooding, Defoliation, Tobacco, Paint Drying, Tractor Operation etc so as the people should come to know the various and the sale of commercial cylinder will be risen.
- The Stock which is maintained by the dealer is not appropriate as per the demand of the cylinders so the companies should force the dealer to keep more stock with him.
- The Government should start checking the commercial outlets for the mal practices done and they should fine the malpractices compulsorily to boost the sales of commercial cylinder.
- Oil Companies should try and reduce the prices of the commercial LPG cylinders so as the people who resist to by can also purchase it because it is expensive than Domestic Cylinder.

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APPENDICES

QUESTIONNAIRE

1.Name of the Customer : _____

2.Address : _____

3.Telephone Number : _____

4.Name of Proprietor/Partner/Contact person : _____

5.Product Manufactured : _____

6.Do you require LPG for any type of process in your organization, if yes for which process : _____

(a) How much is the consumption of LPG/month in your organization?

<i>HP 19</i> <i>kg</i>	<i>HP 14.2</i> <i>kg</i>	<i>BP 19</i> <i>kg</i>	<i>BP 14.2</i> <i>kg</i>	<i>RIL</i>	<i>SHELL</i>	<i>SUPER</i>	<i>OTHERS</i>

(b) What is the size of the cylinder bank? : _____

(c) Number of Working Hours (per day): _____

(d) Number of Burner Installed: _____

(e) Type of Burner : _____

(f) LPG requirement (per hour): _____

(g) Flowrate required: _____

(h) Do you know the properties of LPG: _____

(i) Do you know is their any wastage in LPG: _____

(j) Are your pigtails checked every day by soap water: _____

(k) Name of the supplier: _____

(l) What is the response time of delivery: _____

(m) Would you like to change over from your existing LPG supplier? If yes why, if no why. _____

7. Do you require any other fuel for any type of process in your organization, if yes for which process: _____

(a) Present Fuel : _____

(b) Cost of Fuel (per ltr) : _____

(c) Consumption of Fuel (per month): _____

(d) Number of Working Hours (per month): _____

(e) Number of Burner Installed: _____

(f) Type of Burner : _____

(g) Do you use blower for fuel: _____

(h) If yes, (i) Power of the motor (hp/kW): _____

(ii) Running time per day (hrs): _____

(iii) Unit prices of electricity: _____

(i) Would you like to change over from your existing fuel to LPG? If yes why, if no why: _____

8. Rate the following attributes as per preference while buying gas. Among these attributes rank top 3:

RANK	ATTRIBUTES	RANK	ATTRIBUTES
	QUALITY		SOLUTIONS
	DELIVERY TIME		FREE MAINTANENCE
	SAFETY GUIDENCE		BEHAVIOUR OF SUPPLIER
	RELATIONSHIP WITH SUPPLIER		TECHNICAL GUIDENCE

9. Is your organization registered with central excise?

a. NO

b. If yes, do you avail MODVAT benefits?

Date:

Place:

Signature:

GLOSSARY

A

Always Afloat (In some ports the ship aground when approaching, or at berth.)

AAR

Abbreviation for:

- Against All Risks (insurance clause).

ATDNSHINC

Any time Day or Night Sundays & Holidays Included.

AWWL

Always within Institute Warranties Limits (Insurance purpose).

BB

Ballast Bonus (Special payment above the Chartering price when the ship has to sail a long way on ballast to reach the loading port.)

BB

Bareboat (Method of chartering of the ship leaving the charterer with almost all the responsibilities of the owner.)

B/L

Abbreviation for "Bill of Lading."

Barrel (BBL)

A term of measure referring to 42 gallons of liquid at 60o F.

Base Rate

A tariff term referring to ocean rate less accessorial charges, or simply the base tariff rate.

BCO

Abbreviation for "Beneficial Cargo Owner." Refers to the importer of record, who physically takes possession of cargo at destination and does not act as a third party in the movement of such goods.

BLEVE

Boiling Liquid Expanding Vapour Explosion. Associated with the rupture under fire conditions of a pressure vessel containing liquefied gas.

Boil-Off

Vapour produced above the surface of a boiling liquid

Boiling-Point

The temperature at which the vapour pressure of a liquid is equal to the pressure to which the liquid is subject; this temperature varies with pressure.

Cascade Reliquefaction Cycle

A process whereby vapour boil-off from cargo tanks is condensed in a cargo condenser in which the coolant is an evaporating refrigerant such as Freon 22. The evaporating refrigerant is then passed through a conventional sea water cooled condenser.

CBM (CM)

Abbreviation for "Cubic Meter."

CEFIC

The European Council of Chemical Industries.

Critical Pressure

The pressure of a saturated vapour at the critical temperature, i.e. the pressure required to cause liquefaction at that temperature.

Critical Temperature

The temperature above which a gas cannot be liquefied by pressure alone.

Endothermic

A process which is accompanied by the absorption of heat

Enthalpy

A thermodynamic quantity equal to the sum of the internal energy of a liquid/vapour system plus the external work performed, e.g. the product of the pressure-volume work done on the system.

$$H = U + PV$$

where H = enthalpy (kJ/kg)

U = internal energy (kJ/kg)

P = pressure (kN/m²) V = volume (m³)

Heat of Fusion

Quantity of heat required to effect a change of state of a substance from solid to liquid without change of temperature, (Latent heat of fusion).

Heat of Vaporisation

Quantity of heat required to effect a change of state of a substance from liquid to vapour without change of temperature. (Latent heat of vaporisation).

KT

Kilo or metric ton. 1,000 Kilos or 2,204.6 pounds.

Kilogram

1,000 grams or 2.2046 pounds.

Liquefied Gas

A liquid which has a saturated vapour pressure exceeding 2.8 bar absolute at 37.8°C and certain other substances specified in the IMO Codes.

LNG

Liquefied Natural Gas, the principal constituent of which is methane.

LPG

Liquefied Petroleum Gas. Mainly propane and butane and can be shipped separately or as a mixture.

MBM

1,000 board feet. One MBM equals 2,265 C.M.

Metric Ton

2,204.6 pounds or 1,000 kilograms.

Mile

A unit equal to 5,280 feet on land. A nautical mile is 6076.115.

MT

Abbreviation for "Metric Ton."

Net Tonnage (NT)

$(0.2 + 0.02 \log_{10}(V_c)) V_c (4d/3D)^2$, for passenger ships the following formula is added: $1.25 (GT + 10000)/10000 (N_1 + (N_2/10))$, where V_c is the volume of cargo holds, D is the distance between ship's bottom and the uppermost deck, d is the draught N_1 is the number of cabin passengers, and N_2 is the number of deck passengers.) "Ton" is figured as an 100 cubic foot ton.

NGL

Natural Gas Liquids. Liquid fractions found in association with natural gas. Ethane, propane, butane, pentane and pentanes plus are typical NGLs.

Saturated Vapour Pressure

The pressure at which a vapour is in equilibrium with its liquid at a specified temperature.

Vapour Density

The mass per unit volume of a gas or vapour under specified conditions of temperature and pressure

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